IMPROVING HEALTHCARE THROUGH INFORMATION TECHNOLOGY

EMRS: IMPROVING IMPLEMENTATION, UTILIZATION AND PATIENT SAFETY

by

David J. Feinstadt
MBA Candidate, Management of Technology, Biotechnology Specialization,
Segal Graduate School of Business, Simon Fraser University, 2008
B.Sc., Integrated Sciences, University of British Columbia, 2004

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Name: **David J. Feinstadt**

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Supervisory Committee:

_____

Pek-Hooi Soh
Senior Supervisor
Assistant Professor

_____

Elicia Maine
Second Reader
Assistant Professor

Date Approved: _____

ABSTRACT

The primary objective of physicians is to provide the highest level of care possible to their patients. Currently, only a very small percentage of physicians in North America utilize Electronic Medical Record Systems, EMRs in their practices. EMRs are computer systems that are able to store patient records, manage schedules, as well as an array of other functions. These systems are capable of helping to raise the quality care in which physicians are able to provide by improving access to crucial patient information as well as making offices more efficient. A review of the literature on EMRs and interviews with a leading physician were conducted. This facilitated the development and analysis of several workflows. Weaknesses within the current workflows were identified, and possible solutions are discussed, including the development of new EMR functionality and usability. Finally, several business opportunities are proposed around the development new of EMRs, EMR modules and EMR implementation consulting.

Keywords: EMR, Electronic Medical Records, Healthcare information technology

Subject Terms: Healthcare Information Technology

EXECUTIVE SUMMARY

Historically, physicians in primary healthcare settings recorded patient information in paper files and scheduled patients on large paper daily calendars. However, in this age of healthcare information technology, electronic medical record systems (EMRs) are becoming more widely adopted. These systems are capable of storing patient information that can be accessed by multiple users concurrently and from remote locations. EMRs have the capability of improving the quality of care which physicians provide by closing feedback loops within the current workflows, such as when patients are required to have tests or consults with external service providers. These external providers range from medical specialists to medical imaging offices and laboratory test facilities.

Primary care physicians routinely send patients for tests, procedures or consultations with external service providers such as laboratory test facilities, medical imaging facilities as well as specialists such as obstetricians and orthopaedists. Numerous feedback loops were identified when the workflows associated with scheduling patients for internal appointments, external appointments with the service providers, as well as tracking patients and reports throughout the process were analyzed. The implication of having an unclosed feedback loop can result in severe medical implications for the patient, legal implications for the physician and service provider as well as others. EMRs have the potential to help mitigate many of these unclosed feedback loops by providing automated reminders to the users as well as through the

potential integration of different EMR systems so that they have the capability to interact with each other. Therefore, an increased adoption of EMRs by primary care providers would be beneficial not only for the physicians but also for patients. If EMRs contained increased functionality and were easier to use this could further help to expedite adoption.

There are a number of barriers to the adoption of EMRs that must be mitigated in order to help facilitate the ongoing development and adoption of EMRs. These barriers include cost, complexity, lack of functionality and the inability for the different systems to fully interact with each other. In order to increase the adoption of EMRs by primary healthcare providers, several government ministries as well as medical associations are advocating for the adoption of these systems. They are also assisting with the development of EMRs. Practice Solutions, which is a Canadian Medical Association Company, Infoway and CanadianEMR are examples of such companies.

With the EMR market expected to grow significantly over the next decade, there are a number of potential business opportunities that arise around EMRs. Three such business opportunities include the development of new EMRs, the development of modules for EMRs, and the initiation of consulting businesses to assist physicians with the selection and implementation of EMRs.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

CMA	Canadian Medical Association
CPSA	College of Physicians and Surgeons of Alberta
EMR / EHR / EPR	Electronic Medical Records, also known as Electronic Health Records, Electronic Hospital Records and Electronic Patient Records.
HIT	Healthcare Information Technology
Physician	A medical doctor at a primary care facility
PITO	Physicians Information Technology Office
Service Provider	For the purposes of this paper, the term Service Provider refers to specialists, laboratory services or imaging services outside of the referring physician's practice

Foreseeability of Harm

"[B]ecause the danger is to be foreseen, there is a duty to avoid the injury…if [a person] is negligent where a danger is to be foreseen, a liability will follow."

-Justice Cardoza

1: INTRODUCTION

1.1 Overview

The medical profession frequently adopts and uses leading edge bio-medical technologies, medical equipment technologies and pharmaceuticals. It is also a profession in which vast amounts of patient data must be collected, stored and shared amongst many different user groups, including other primary care facilities, specialists and billing agencies. Each of the groups has a different set of demands, uses and requirements for the data. For example, the format in which data is entered and reports are generated varies across different users and specialties. Moreover, many of these user groups need to share data and interact with each other as patients are transferred between them for consultations, procedures and examinations.

Electronic Medical Record systems (EMRs) are software systems that are capable of storing patient records and scheduling appointments, instead of using a pencil and paper system. For various reasons, however, primary healthcare providers in North America have been slow to adopt EMRs; some large medical imaging offices in Vancouver still use pen and paper scheduling systems. For a profession that is accustomed to using leading edge technologies, it is somewhat surprising that the medical profession has been so slow in adopting EMR.

The main objective of primary care physicians is to help improve the health of their patients by providing high quality care. They try to accomplish this by the timely diagnosis of current and potential problems, followed by prompt treatment. Physicians

utilize many different tools in order to try to help their patients. Outside of their immediate practice, they often use medical imaging, laboratory tests, and specialists for consults and specialty procedures. Included in this group are not only medical specialists such as surgeons and internists, but also groups such as psychologists and physiotherapists. Physicians can also utilize Healthcare Information Technology (HIT), such as EMRs, to help improve the level of patient care and safety through improving the efficiency of workflows within the practice and through closing feedback loops, especially when external parties are utilized during the diagnosis and treatment process. By improving efficiency, EMRs also have the potential to help increase the financial bottom line of the practice.

Various aspects of HIT, specifically EMRs, are discussed in more detail in section 2 of this report. The focus is on highlighting and analyzing EMRs as a form of healthcare information technology that could be beneficial for both patients and healthcare providers. In the current environment of medical malpractice, it is essential to have systems in place to minimize risk to the patient and hence, liability to the physician. EMRs can help primary care physicians in their day-to-day practice by assisting them with accessing patient records; thus, helping to enable physicians to deliver high quality medical care to their patients. Several aspects of EMRs are discussed, including the benefits of the system and the barriers to adoption, as well as various government programs aimed at helping to facilitate the adoption of EMRs. In addition, several key workflows found in primary healthcare practices, principally around scheduling internal and external appointments and tests along with feedback loops are analyzed. The analyses are to help identify key areas where HIT/EMRs could benefit the practice,

physicians and patients alike in the goal of delivering and obtaining a high standard of medical care.

1.2 Organizational Layout of Analysis

The analysis of EMRs and their application in primary healthcare facilities is comprised of three main sections. These three sections are:

- a review of EMRs;
- an analysis of the workflows in primary healthcare facilities; and
- recommendations.

The first section revolves around electronic medical records and includes an introduction, overview and brief history of EMRs. The technology is then described, followed by a discussion of the key benefits. As with all technologies, there are barriers to its adoption, which are imposed by those who are affected by the implementation of the technology. These barriers are discussed along with what is being done to help mitigate these barriers. In addition, the EMR market will be analyzed, and this analysis will in turn be utilized in the final section of the paper, where various business opportunities will be addressed.

The second section is an analysis of some of the workflows in a primary healthcare facility that could be directly affected by the utilization of EMRs. The workflows revolve around scheduling patients for internal and external appointments as well as external laboratory and imaging exams. Within these workflows, numerous feedback loops are identified and their implications discussed. Potential problems that could result from not utilizing an EMR are also analyzed.

The final section involves recommendations for both primary healthcare facilities as well as current and potential industry players. Ways of mitigating the risks identified from open feedback loops are given, along with a discussion on how EMRs could be beneficial. The benefits could arise from increased adoption, functionality and usability of EMRs as well as improved access to data by multiple users and systems. In addition, business opportunities around EMR development and implementation are discussed, prior to the concluding section.

1.3 Research Methods

Research for this paper was conducted through the utilization of a number of resources. Firstly, broad-based internet searches were conducted with search engines such as Google as well as the reference libraries accessible via the SFU library. A wide range of keywords were used in these searches: EMR, electronic medical records electronic, health records, EHR, and healthcare information technology. These searches were used in order to gain a general knowledge with regard to the definition and functionality of EMRs, as well as the EMR market in North America and in the Rest of the World (ROW). Once a general understanding of EMRs was obtained, more in depth analyses of the workflows within primary care healthcare practices were conducted. This facilitated the identification of areas where HIT/EMRs could be utilized in order to benefit both patients and healthcare providers.

The research pertaining to primary healthcare practice workflows was done mainly through interviewing key industry players. Specifically, a partner at a mid-sized primary healthcare facility in Vancouver, BC, who has over a quarter century of experience in primary care medicine, operating private medical practices, as well as

consulting to leading Canadian law firms on medico-legal cases. Additional information about the costs and benefits of EMRs and the current state of adoption was also obtained \through scholarly literature searches as well as through the webpages of companies who are developing and commercializing EMRs.

2: ELECTRONIC MEDICAL RECORDS (EMR)

*"The American Academy of Family Practice has asserted that the effective use of Information Technology is essential for the provision of high quality care in the increasingly complex healthcare field." (*Gans *et al*, 2005*)*

EMRs are also known as Electronic Hospital Records (EHRs) and Electronic Patient Records (EPRs). These systems have similar purposes, to electronically record and store patient information. The terms EMR and EPR are more often used to refer to systems in private practices, while EHR is more frequently used for systems that are utilized in hospital settings. For the purpose of simplicity, the term EMR will be used throughout; however, the discussion and analysis of the systems may also apply to hospital settings.

2.1 Overview of EMRs

In the late 1960s, Larry Weed first introduced the idea of recording patient records electronically instead of on paper when he presented the concept of the Problem Oriented Medical Record in medical practices. The first medical records system was developed by the Regenstreif Institute in 1972.[1] While physicians like the idea in

[1] For details see this website www.xwave.com/healthcare/cms/about_us/doc/industry_analysis_electronic_medical_record_system_3.doc

principle of electronic patient records, their adoption of such systems has been rather slow, especially in North America. Many of the early EMRs were derived from basic scheduling and billing programs. In order to enter the EMR market the companies that provided these basic systems tried to add on EMR functionality. This, however, resulted in the development of bulky non-user friendly systems. It is estimated that EMR use in hospital settings in the US is approximately 20%, with even less in Canada, and about 5% in U.S. clinics, with about the same level of adoption in Canada.[2]

Doctors are required to collect, document, and review vast amounts of information on their patients. The information contained in the patient files ranges from basic contact information, to notes taken during visits, to results from tests and procedures done at external service providers. These external service providers include facilities that conduct laboratory tests, specialists such as obstetricians and orthopaedic surgeons, as well as medical imaging. Doctors' offices that do not use EMR systems have large amounts of square footage occupied by racks and racks of paper files. In some offices, this can equate to 100-300 ft^2 or more, and, with the implementation of EMRs, this can be reduced to a fraction of the space because paper records will not be required.

2.2 Description of EMR Technology

EMRs software systems are comprised of different modules. The modules are dependent on the facility in which the system is deployed. Figure 1 depicts some of the modules contained within an EMR system. The centre of the diagram is the core of the system with various components connected to it. These components vary from EMR to EMR depending on the company that is providing the system and the facility where the

[2] Ibid.

system is being installed. Typically, the modules for an EMR include, but are not limited to, scheduling, basic patient information, documenting patient visits, prescription writing, managing documents (such as referral letters and external reports), and billing. Hospital EHRs are frequently more robust and contain additional modules that are not required in primary healthcare facilities, such as messaging and hospital discharge summaries.

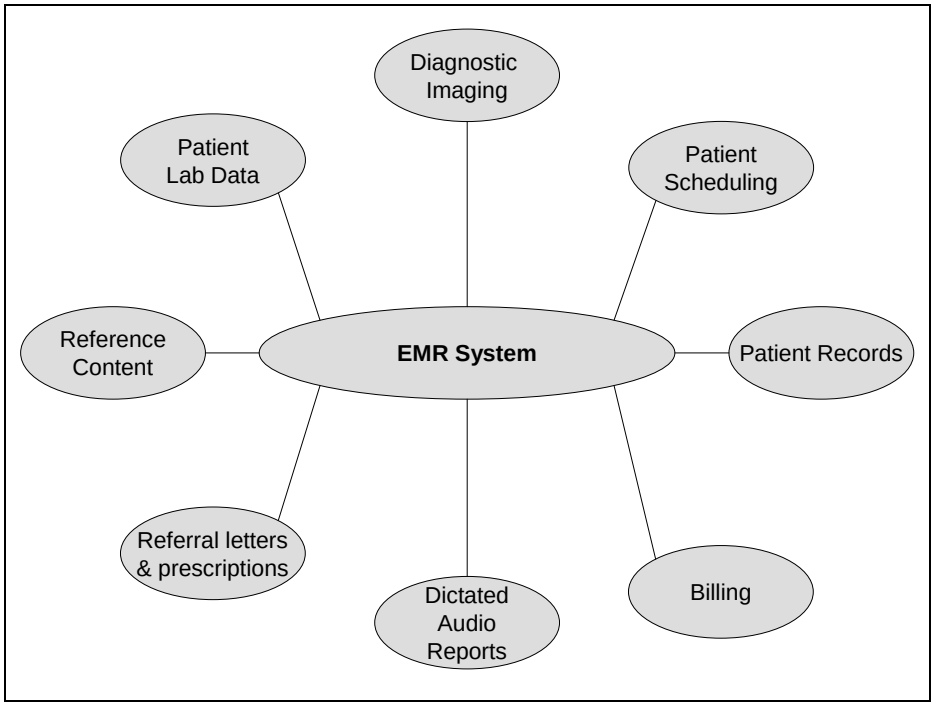

Figure 1 – Modules Contained within an EMR System[3]

2.3 Benefits of Utilizing EMRs in Primary Healthcare Facilities

The implementation and utilization of EMRs provide numerous benefits to both patients and the primary care facility itself. EMRs provide improved access to medical

[3] Created by author

record information, including the ability for multiple users to concurrently access patient information, whether they are accessing the system from within the facility or from a remote location. Moreover, physicians can search for all patients with a given diagnosis, combination of diagnoses or those who are on a particular medication. This functionality is very useful for when new data regarding multiple drug interactions or other regulatory information becomes available, as the physician may want to contact those patients who are taking a certain pharmaceutical or combination of pharmaceuticals. In British Columbia, full service family physicians are able to make additional revenue caring for patients with chronic and complex diseases such as diabetes, hypertension, and congestive heart failure. Therefore, being able to identify the number of these patients within a practice could assist in ensuring these additional revenues are recognized.

In addition, EMRs can help improve workflows within the practice through the automation of functions and activities as well as by decreasing the amount of time required to access patient records. One key benefit of EMRs, which is yet to be fully developed, is the ability of the system to provide key information that would allow internal and external parties (Service Providers), to ensure that feedback loops are closed. This is a key step to ensuring that patients and reports are not forgotten. Table 1 below outlines the key benefits of EMRs for primary care physicians.

Key Benefit of EMRs for Physicians
• Improved access to patient records • Ability for multiple concurrent user accessibility to patient records • Improved office workflows • Ability to integrate functions such as billing & scheduling • Data protected in case of disasters through off-site back-up and disaster recover features (e.g. floods, fires or earthquake) • Ability to save office space via the reduction of bulky paper file systems • Ability to better utilize human resources within a practice • Ability to better manage errors (e.g. Drug interactions, billing/coding errors, as well as lost, misplaced or misfiled records) • Ability to conduct diagnostic searches

Table 1 - Benefits of EMRs[4]

2.4 Driving Forces towards the Adoption of EMRs

Within Canada, there are a number of agencies, including the Physician Information Technology Office (PITO) and Canada Health Infoway, that are working with physicians, industry partners, and the relevant health ministries and associations in

[4] created by author

order to help facilitate the adoption of EMRs. In 2006, Health Canada published "The EMR Toolkit – Implementing electronic medical rectors in primary health care settings". This toolkit outlines what physicians need to know about implementing an EMR and includes information ranging from how to select a vendor to how to optimize an EMR once it is implemented. The publication of this toolkit demonstrates that that the Canadian government is backing the implementation of EMR systems in primary healthcare practices.

Medical agencies are also very involved in promoting and advising on the implementation of EMR. The College of Physicians and Surgeons of Alberta (CPSA) published a set of guidelines in 2004 titled, "Transition to Electronic Medical Records (EMR)". These guidelines identified five key principles to guide the transition process, as shown in Table 2 below. The guideline goes on to provide recommendations on how the implementing practice should proceed during the transition process. This is another example of the support the medical community is receiving in order to help with the implementation of EMRs in primary care practices. Driving forces towards adoption will be further discussed in sections 2.4.1 and 3 respectively around the workflow analysis of small to mid-sized primary health care practices. Even with all of the benefits of EMRs and forces driving EMR adoption, there are still numerous barriers that must be overcome. These issues will be addressed in section 2.5.

CPSA's Five Principles to Guide the Adoption Process of EMRs
• Patient information must be secure. • Privacy of patient information must be maintained. • The integrity of the medical records content must be maintained. • The integrity of the clinical workflow supported by the medical record must be maintained. • Continuity and quality of care must be maintained through the transition process.

Table 2 - CPSA's Five Principles to Guide the Adoption Process of EMRs[5]

2.4.1 Canadian Organizations Supporting and Driving Adoption

In Canada, there is now a great deal of incentive for physicians to implement EMRs in to practices. A number of organizations are assisting physicians with implementing EMRs. In this paper, four representative organizations were chosen to highlight this support, they are PITO, CMA via Practice Solutions, Infoway, and CanadianEMR. These organizations were selected because they provide a wide range of organizational aids and support that facilitate the adoption of EMRs. The variety of support includes an organization that provides selection, implementation, and financial assistance, a CMA company that develops EMR solutions, a federally backed organization that invests in EMRs and a physician-to-physician based website.

[5] created by author

Physician Information Technology Office (PITO)

The primary responsibility of PITO is to support BC physicians with implementing EMRs in their practices, starting with pre-implementation planning and selection of an appropriate vendor and IT requirements. According to the PITO website (www.pito.bc.ca) the initiation of PITO was "an outcome of the 2006 Agreement, Appendix C (www.bcma.org), in which the provincial government and the BCMA agreed to work collaboratively. In order to "co-ordinate, facilitate and support information technology planning and implementation for physicians… including the development and implementation in British Columbia of standardized systems of electronic medical records". PITO's main focus is on the implementation of technology in physicians' offices. They consider EMRs and technology a vital link in e-Health. The office is governed by three practising physicians who are appointed by the BC Medical Association (BCMA).

PITO currently has three funding programs,

- an Implementation & Transition Support Program,
- an Early Adopter Program; and
- a Pre-Purchase Program.

The first program provides funding and support to assist practices in implementing PITO-qualified EMRs. There are several companies in the process of becoming PITO-qualified. However, currently only one EMR vendor, Med Access Inc, has met the requirements. The second program is for physicians who implemented an EMR system prior to June 20, 2006 and PITO provides reimbursement for ongoing operational costs.

The third program also provides funding to physicians to assist with the implementation costs of EMRs.

Canadian Medical Association (CMA)

The Canadian Medical Association (CMA) has a company called Practice Solutions, which develops and sells a number of software programs including PS Suite. PS Suite includes an EMR as well as a scheduling and billing program. They claim that "[s]ince 1982, [their] products have been trusted by more that 2,600 doctors at more than 825 medical clinics representing every kind of practice".[6] However, it is important to note that these numbers are not referring to only EMRs but include billing as well as other software systems.

In addition to developing and selling EMRs, Practice Solutions also conducts training seminars aimed at educating physicians, regardless of the size of the practice in which they work in or their specialty. The seminars focus on "easy-to-implement solutions that emphasize high-quality patient care".[7]

Canadian Health Infoway

Canada Health Infoway (Infoway) strategically invests in companies and projects in order to advance the implementation of a comprehensive integrated electronic health record solution across Canada. Infoway describes itself, as a "federally-funded, independent, not-for-profit organization whose Members are Canada's 14 federal,

[6] See more details in http://www.practicesolutions.ca/index.cfm/ci_id/47458/la_id/1.htm
[7] See reference in http://www.practicesolutions.ca/index.cfm/ci_id/47462/la_id/1.htm

provincial and territorial Deputy Ministers of Health. Infoway is Canada's catalyst for collaborative change to accelerate the use of electronic health information systems and electronic health records (EHRs) [also referred to as EMRs] across the country." The goal of Infoway is that "[b]y 2010, every province and territory and the populations they serve will benefit from new health information systems that will help transform the Canadian healthcare system. Furthermore, by 2010, 50 per cent of Canadians and by 2016, 100 per cent of Canadians will have their electronic health record available to the authorized professionals who provide their health care services".[8]

CanadianEMR

CanadianEMR is free resource website, which was designed to help physicians and others in the medical practice setting in Canada to compare, select and implement EMR systems into their practices. CanadianEMR's slogan is "Allowing Canadian Physicians to Share Information About Electronic Medical Records". Information on the site is from physicians who use EMRs or is from EMR vendors. The first goal of CanadianEMR is "[t]o facilitate and support the adoption and use of Electronic Medical Record systems by Canadian physicians and their staff in order to enhance the delivery of efficient, high-quality care to Canadians" [9]

Three of the main tabs on the site are for a 'blog', 'comparison engine' and 'vendor profiles'. The blog tab highlights various key issues surrounding HIT and EMRs. Two recent posts (as of July 16th, 2008) are titled "The Shift to Digital Media –

[8] For more information see: http://www.infoway-inforoute.ca/en/WhoWeAre/Overview.aspx
[9] For more information see: http://canadianemr.ca/

Will Print Based Journals Become Extinct?" and "Canada and US in Race to be Slowest Adopter of EMRs in Developed World". The 'Comparison Engine' tab allows users to compare features and aspects of different EMR systems. While the 'Vendor Profiles' tab provides links to a number of companies with EMRs along with a table with the vendors name, product name, number of verified raters and the most recent rating. Users who have signed in are able to view the various postings about the different systems. Anyone can register for free access to the site.

2.5 Barriers to Adoption

Despite the extensive literature and organization support for EMR adoption, there exist numerous barriers hindering its adoption in primary healthcare facilities. The key barriers to adoption are listed in Table 3. These barriers are present at various levels, ranging from the Healthcare Authorities to the individual practice to concerns regarding the technology. In the following paragraphs, the corresponding barriers are discussed under the macro, micro and technology levels.

List of Key Barriers to the Adoption of EMRs
• Costs associated with purchasing EMRs • Substantial financial and human resource costs associated with implementing and supporting EMRs • Large number of service providers • Many different systems – therefore difficult to decide which system to implement • 'Islands of data' – many different systems, system and input requirements as well as uses of electronic medical records • Physician office's work on routines and process re-engineering can be costly, difficult and there may be resistance to change • Bureaucracy at the healthcare authority level • Data security and privacy around access to patient records

Table 3 - Key Barriers to Adoption of EMRs[10]

Macro – Healthcare Authorities

As with many bureaucracies, the bureaucrats running the healthcare systems in Canada and the US have been slow to support the adoption of EMRs. One reason for this, especially in the US, is the concern over patient privacy. However, there are

[10] created by author

numerous ways through the use of technology to mitigate this barrier and these are discussed in the Technology section below. If anything, the use of EMRs could reduce some concerns regarding privacy. With paper-based systems, physicians regularly take files home, to the hospital, or to some other location where they work. Therefore, there is the chance that the records could be misplaced or others might be able to access them, not to mention there are no passwords on paper-based files. Regardless as to whether a filing system is paper or computer-based, there will be some degree of risk that through negligence or criminal activity, security and privacy of the records could be breached. However, unlike a paper-based system, with an EMR access to and changes made within the system and records can be tracked. Therefore, the party or parties involved in the unauthorized release of the information can be identified.

Furthermore, many systems still appear to be bulky and there is the issue of different groups within the healthcare system requiring different information and different methods or formats for data entry, storage, and retrieval. This in turn, complicates the sharing of data between users. Additional barriers include the cost of the software systems, hardware, training and maintenance. Over time, these barriers are being overcome as the benefits to adoption as well as additional support programs are being initiated. According to Gins *et al* "[t]he American Academy of Family Practice has asserted that the effective use of information technology (IT) is essential for the provision of high-quality care in the increasingly complex health care field" (2005).

Micro – Primary Healthcare Facilities

The barriers to adoption at a micro level include: the high cost of implementation,– financial and training - the lack of standardization of systems, concerns about privacy, as well as inertia – people are used to their current systems and routines and generally do not like change. The concerns about privacy, can be mitigated through the use of technology, and are discussed in the Technology section below. Moreover, they are a large number of EMRs, which are being offered, and it is not easy, especially for smaller practices, to determine which system best meets their needs. This problem is compounded by the fact that a large number of companies who offer EMRs are small, and there may be some concern about their financial stability, and whether they are going to be around in the future to provide adequate technical and customer support.

The financial cost of implementing an EMR system is another barrier to adoption. According to Ken Terry, a technology editor for Medical Economics, the initial cost of an EMR including hardware, software, and training ranges from $15,000 to $50,000 per physician. The total costs broken down per doctor per month on an ongoing basis are approximately $1,500 to $2,000 (2003). It is clear that the actual costs vary depending on the system that is being implemented, the existing IT infrastructure and the amount of training required. However, with organizations such as PITO providing financial assistance, this barrier should be becoming smaller and smaller.

With respect to standardization, currently different users, such as General Practitioners and various specialists each require a pseudo-separate system. That is, each want to capture and record information differently, because each group will use the system differently based on the type of practices they run, patients they see, and

information that they collect. Therefore, if each group requires a separate system, it is very difficult to develop a single system for all or a system that is able to interact with the various sub-systems that each group is demanding. Furthermore, information can be entered into the system in various ways ranging from drop down boxes to open free text entry fields. This makes it extremely difficult on a technical level for the various systems to interact.

In addition, doctors' offices are extremely busy and the decision maker for implementing new systems is generally one of the physicians. They generally do not have the extra free time to research and undergo the pain of implementing a new system. Medical practices run on routine; therefore, it is very difficult to change the workflows of all those involved including, IT consultants, receptionists, doctors, and schedulers. Hence, it is difficult for a practice to research and implement EMRs due to its limited human resources and expertise with HIT.

Technology

When it comes to the technology of EMRs, there are three areas of concern:

- access to patient data,
- privacy, and
- security.

It is crucial that only authorized users have access to the data and that others are not able to hack in to the system. It is also important to maintain the integrity of the data from a technical perspective, i.e. the data entered is the same data that is retrieved later. This does not account for data entry errors. If anything, EMRs could help mitigate some of

the issues around trying to read a physician's handwriting, which can be virtually impossible. Errors in reading a physician's hand written notes can and regularly do result in patients being given the wrong medication or wrong dosage. If a patient receives the wrong medication or dosage, deadly consequences may occur. In order to mitigate these potential errors, some systems have medical databases that will for example crosscheck a pharmaceutical that is prescribed with other medications that the patient is on for contra-indications.

Many of these technical concerns are not unique to EMRs and have been addressed with other electronic systems which store personal information such as banking and tax filing. Therefore, it should not be a significant obstacle to overcome for the developers of EMRs and EMR related products. For example, PITO has a conformance requirement that all servers be securely stored off-site. There are numerous ways to ensure that the data is both private and secure, for example, through the use of multiple complex passwords, firewalls, and restricted access settings (i.e. restricting what each user has access to). In 2007, the BC Ministry of Health's Electronic Medical Record (EMR) project solicited proposals for EMR systems. However, the Ministry outlined key requirements including security and privacy, thus ensuring that there is an appropriate standard in place in order to protect patient's privacy and to ensure that systems are secure.[11]

Another barrier is based on the fact that there are 'islands of data' that are present in the healthcare industry. The 'islands of data' are caused by the different systems that are present for the various groups within the industry such as laboratory testing, medical

[11] http://www.bcbid.gov.bc.ca/open.dll/submitLogin?disID=9800486 – Supplier Attachment Exist - Appendices F & G

imaging, primary care facilities, hospitals and so on. Each of these systems may have different data structures and it is extremely difficult to develop a system that is able to collect physician-entered data in an appropriate structure that is understandable from a software programming perspective for other systems to utilize. However, as industry standards are being set, the barrier between the islands should be reduced, until there is seamless integration. The BC Ministry of Health, through the electronic medical summary project (E-MS), is working on developing a system/protocol for transferring "a subset of patient data [that is] suitable for communication among primary health care practitioners and other health care providers for the purpose of sharing the care of a patient". In order to maintain security and privacy, the system contains numerous layers of security so that "[u]sers will only gain access to the e-MS once they are successfully authenticated, based on a user id/password challenge, first by their EMR or web-based e-MS and secondly by the VIHA firewall as valid e-MS users".[12] Project like this are designed to alleviate patient's concerns regarding the security and privacy of their healthcare records when other healthcare professionals are provided access to a subset of the records.

Furthermore, regarding the transfer of patient information to another healthcare provider, "[t]he College of Physician and Surgeons also indicates in Section M-4a of their policy manual that 'where two or more physicians are jointly caring for the same patient as in a referral or similar situation, formal consent to share or provide patient information is not required. A physician in referring a patient to another physician is obliged to provide information which is essential to the care of that patient and likewise the

[12] see more details in www.e-ms.ca

consultant is to provide his or her opinion and further information to the original physician'".[13] However, if information is transferred to other service providers, then only pertinent information should be transferred, i.e. basic contact information and information specific to the reason for the referral. Service providers should not be granted full access to patient records and medical history. Therefore, technology through programming should be utilized in order to ensure that the patient's privacy is maintained.

Other Barriers

Other barriers to adoption include the reliability and differentiation of EMR companies themselves. With some companies, especially the smaller ones, there can be some concern over their financial stability, with respect to them operating as a going concern in the future in order to provide ongoing customer and technical support and to develop regular upgrades. Furthermore, the large number of different EMR systems that are available can make the process of selecting an appropriate system appears to be overwhelming. Rural physicians may also consider the potential delays in customer service another barrier to adoption. Physicians therefore may be more inclined to avoid the potential hassle and to continue using their current paper-based or stand-alone electronic system.

2.6 EMR Market

In 2005, the U.S. spent 15.2% of its GDP on healthcare, which equates to $6,350 per capita. Canada, on the hand, spent 9.7% of its GDP or $3,419 per capita on

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For more information see: www.e-ms.ca/privacy_security.php

healthcare (www.who.int/countries/). "The U.S. Market for EMR Technologies" report published by Kilogram Information in 2007 estimated the EMR market in the U.S. to be US$1.2 billion and forecasts that it will grow by nearly 400% over the next eight years to approximately US$5 billion in 2015 (Pizzi, 2007). There are hundreds of companies in the U.S. and Canada that are developing and selling EMR systems. Most of these companies appear to be small, with a small percentage of firms selling the majority of EMRs. However, there is still an extremely large potential market for EMR sale, because only a small percent of Canadian and U.S. primary healthcare facilities have adopted EMRs to date (Table 4). In addition, agencies such as PITO, CPSA, Canadian Medical Association (CMA), the Canadian government as well as their counterparts in the U.S. are strongly supporting the adoption of EMRs in all primary healthcare facilities.

Country	Percent of Physicians with some form of EMR
Canada	23%
Netherlands	98%
New Zealand	92%
United Kingdom	89%
Australia	79%

Table 4 - Adoption of EMRs by Physicians[14]

[14] created by author, with data from The U.S. Market for EMR Technologies report published by Kalorama Information in 2007

3: ANALYSIS OF A SMALL TO MID SIZED PRIMARY HEALTHCARE PRACTICE

Physicians are, or at least should be, focused on providing the best possible care for their patients. This is not an easy task because of the numerous demands on them, which range from managing various aspects of the practice to splitting their time between their practice and one or more hospitals. Therefore, physicians could greatly benefit from the use of current and new information technologies. One piece of information technology that could be used to help physicians is an EMR system. EMRs have the capability of improving several aspects of a primary care facility including the workflows associated with internal appointment scheduling and external appointment scheduling, ensuring follow-ups are conducted on external appointments and tests as well as other aspects of practice and patient management. The workflows for each of these are outlined and analyzed in the subsequent sub-sections.

3.1 Appointment Scheduling

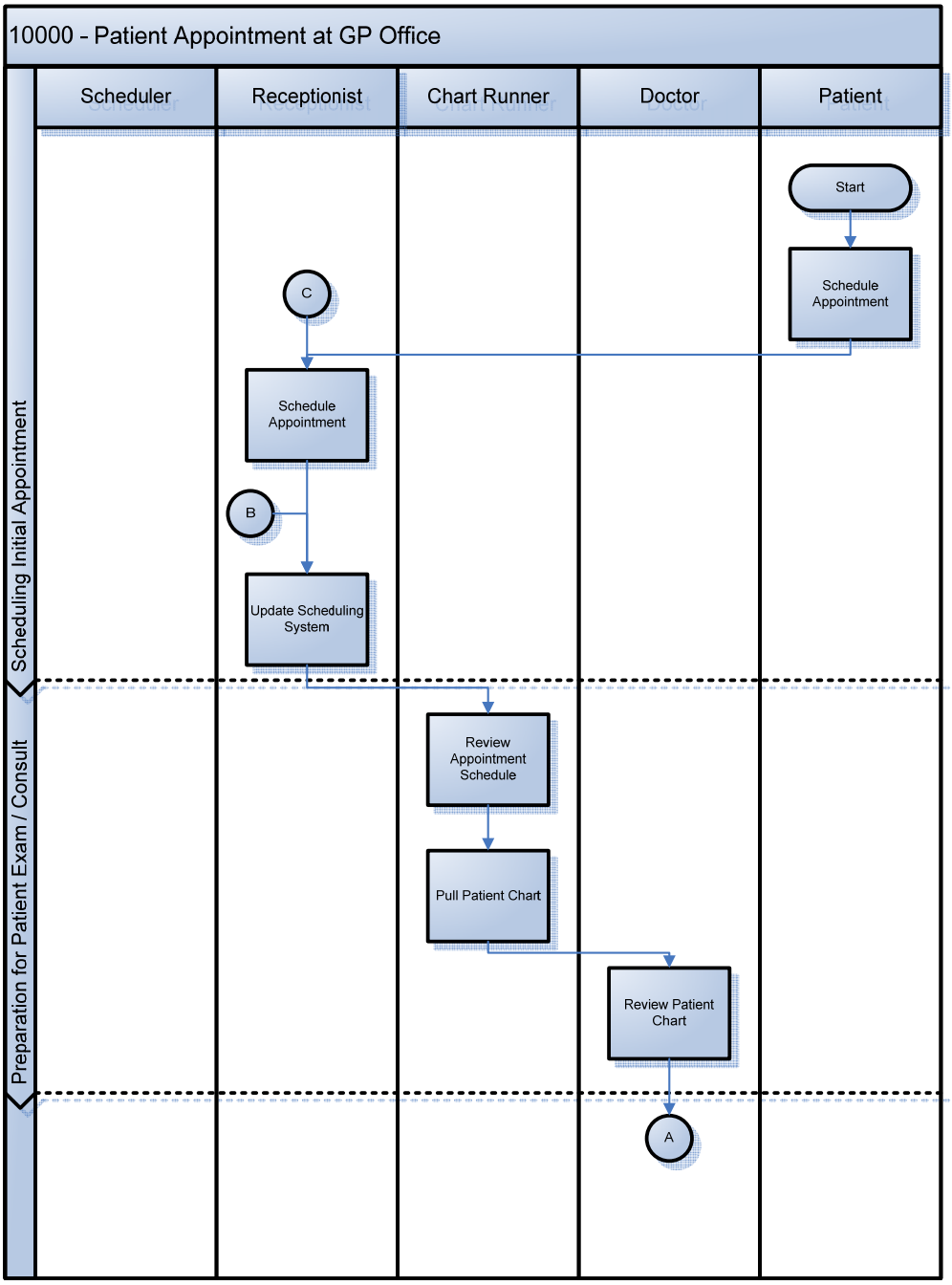

Figure 2 - Appointment Scheduling Flowchart[15][16]

[15] created by author

[16] A, B & C in Figure 2, 3 and 4 are used to show the connections between the flowcharts in these figures

Offices that do not have EMRs occasionally have stand-alone electronic scheduling and billing software. However, there are still offices that have neither EMRs nor electronic scheduling systems and schedule patients on large paper appointment sheets. Using a paper-based scheduling system has many limitations. One of the main limitations is that only one person at one location is able to see and change the schedule. One advantage of electronic-based scheduling systems is that several users at different locations are able to concurrently access and modify the schedule.

Figure 2 outlines the workflow process for scheduling patient appointments when EMRs are not used. There are five main roles which are being highlighted: the scheduler, receptionist, chart runner (someone who files, updates and fetches charts), doctors, and patients. When a patient wants to schedule an appointment traditionally, s/he calls the office and schedules an appointment through the receptionist. The receptionist will then update the scheduling system - regardless of whether it is an electronic or paper-based system. On a regular basis, usually daily, the chart runner will check the list of scheduled appointments and will 'pull' the charts for the physician to review prior to the appointment.

In offices with EMR systems there would be no need for chart runners as the charts would be stored electronically in the system and paper files would primarily be for patients whose files have not been converted yet or are no longer current patients. Therefore, the utilization of an EMR or electronic scheduling system would have several benefits including improved efficiency, improved workflows, and decreased expenses. As chart runners (filers) would no longer be needed, the financial and human resources associated with this role could be reallocated for other activities or services. This could

help the practice to provide a higher level of care for their patients. The reallocated resources could be used for such tasks as calling up to confirm appointments, following up on missed appointments, and proactively booking appointments with patients based on the request of a physician.

3.1.1 Patient Appointment

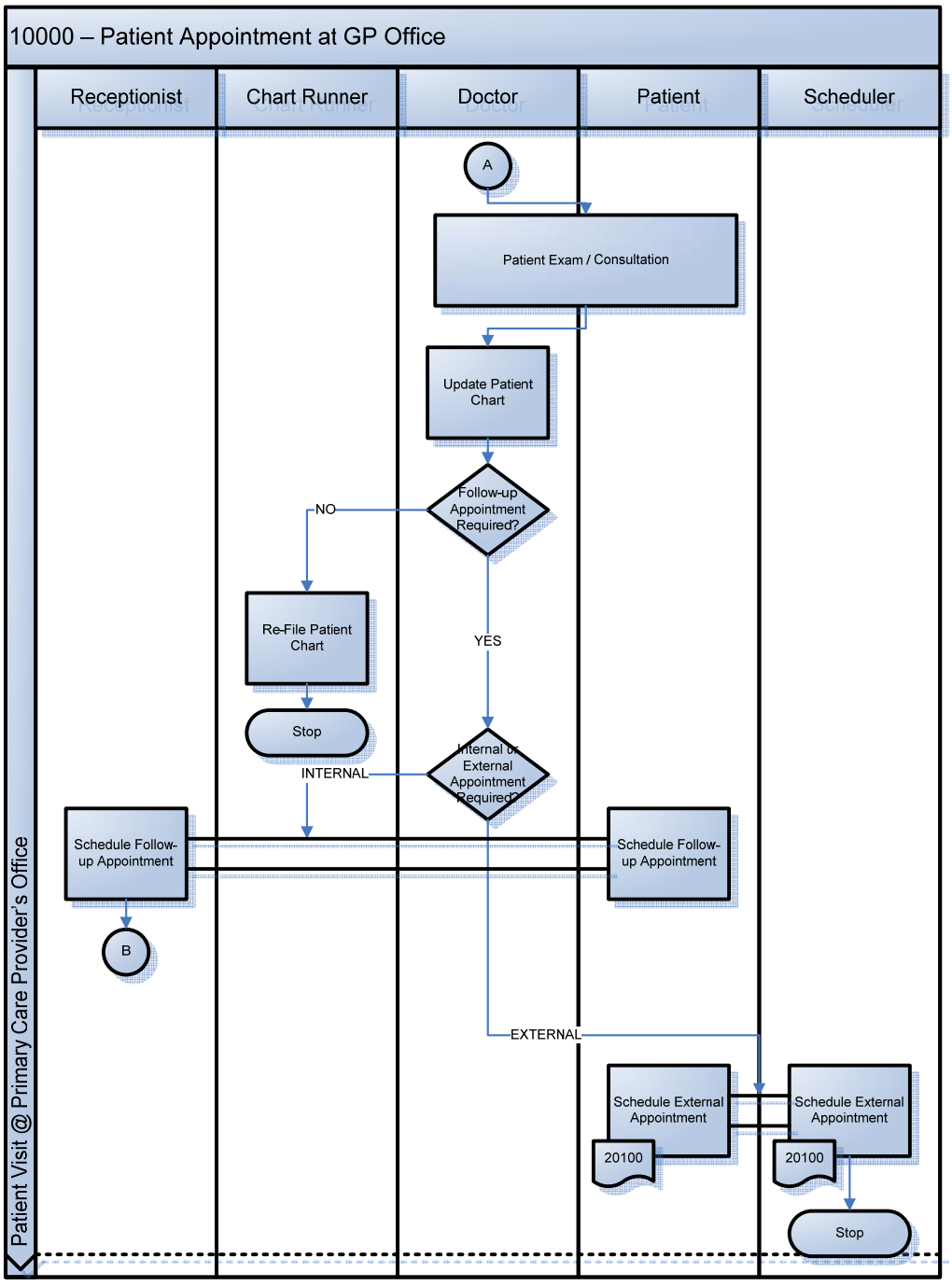

Figure 3 - Patient Appointment Flowchart[17]

[17] created by author

After the patient has scheduled his or her appointment, the patient will need to go the office for the exam, consultation, or procedure. The average encounter a physician has with a patient is ten minutes. Within that time, the physician must conduct an appropriate exam/consult/procedure, and update the patient's chart. Currently, many physicians dictate reports either at the end of the appointment or some time afterwards. There is a significant cost associated with dictating reports. Moreover, there is a time delay between the dictation and the patient's file being updated. During the interim it is plausible that the patient many require an additional visit and in many clinics, especially walk-ins, it may be with a different physician who does not know the patient's complete history or what transpired during the previous appointment. Therefore, if the physician does not have the most up-to-date information about the patient, some of the appointment will need to be used in order to gather the patient's historical information.

During the appointment, the physician will make some notes on the patient. With a paper-based filing system, the notes are handwritten in the chart. One problem with physicians taking notes by hand is that quite often no one other than the physician can read the notes because of the quality of the penmanship. EMRs can eliminate this problem if physicians are able to directly interact with the system during the appointment through a laptop, tablet or workstation installed in the exam room. In addition, during the appointment the physician will determine if a follow up appointment, whether internal or external, is necessary. External appointments could include appointments with a specialist such as a surgeon or an internist, or the appointment may be for a laboratory or medical imaging test. If the follow up appointment is an internal appointment, then the procedures previously outlined for scheduling an internal appointment are followed

(Figure 2). If the appointment is external then the office scheduler, usually someone whose role is to coordinate appointments with external service providers is utilized. The workflow associated with scheduling these appointments will be discussed in section 3.1.2 and depicted in Figure 4. If no follow up is required, then the patient's file is updated. If paper-based files are used then the chart runner will re-file the chart.

3.1.2 Scheduling External Appointments

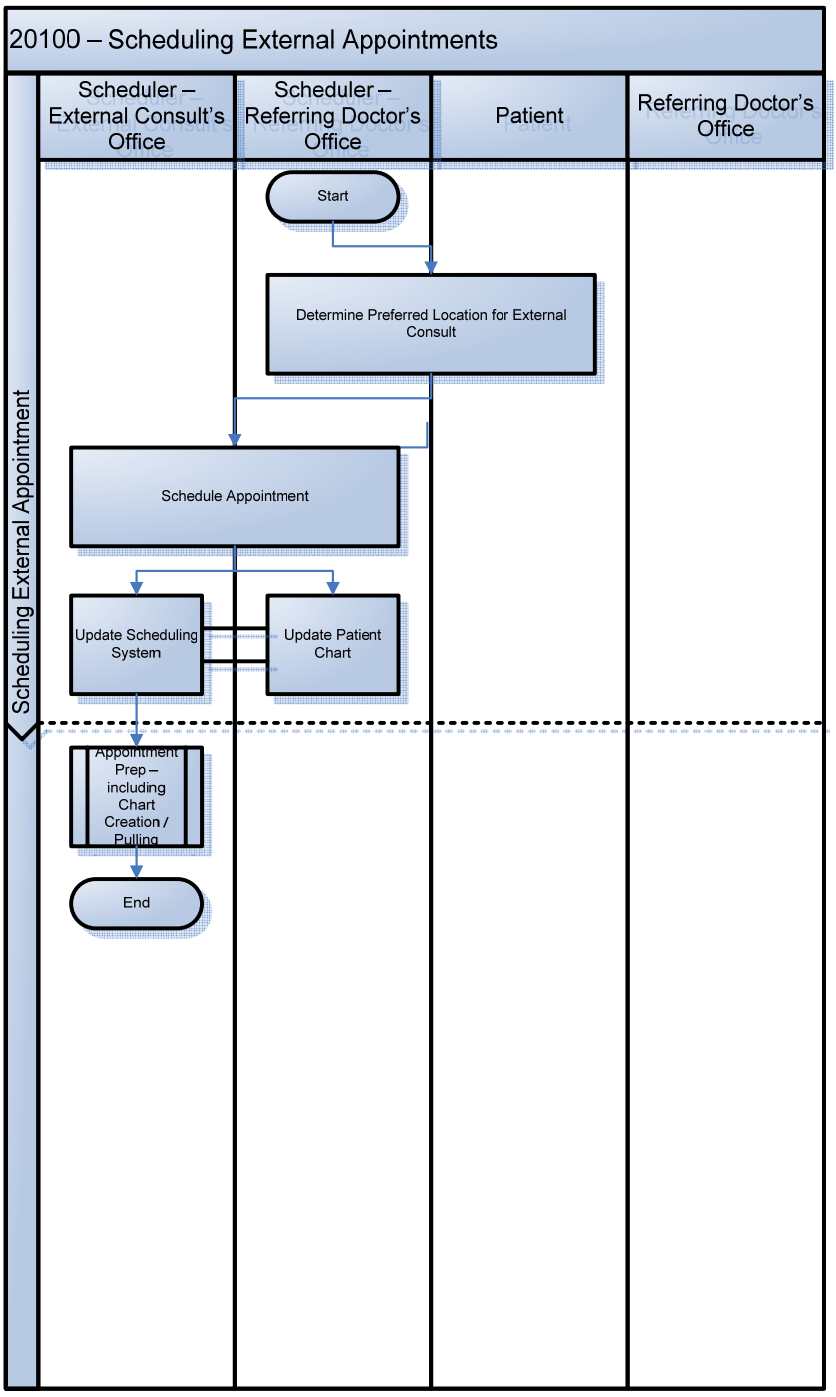

Figure 4 - External Appointment Scheduling Flowchart[18]

[18] created by author

External appointments are sometimes booked directly by the referring office. Typically, the office will have someone who is responsible for making these appointments for the patient. These appointments may be, for example, at a hospital for a CT scan following a patient receiving a concussion. Booking these appointments can be a labour and time-intensive process. The referring physician's office may try to contact a number of clinics, where they are frequently put on hold for potentially long periods of time, until they can get through to the appropriate person to schedule the appointment.

To schedule these appointments, the scheduler at the service provider will need to review their schedule in order to determine when an appropriate timeslot is available. In an ideal situation, this time would also be convenient for the patient; however, sometimes it is not and the process needs to be repeated in order to find a different time or location for the appointment. Once the appointment has been scheduled, the service provider will update their records with the necessary basic patient information including basic personal contact information as well as MSP and other insurance numbers. This information is normally transmitted verbally, and the transmission is not only time consuming, but also has a risk of being mis-communicated, thus resulting in inaccurate information being recorded.

If EMRs had the ability to interact it might be possible for some appointments with service providers to be booked directly by the GP's office. Even if they could not be booked directly, perhaps the systems could interact in such as way that the patient's basic information could be electronically transferred to the service provider in order to update their records. Service providers will however not have full access to the patient's medical records, but rather limited information depending on the type of service provider.

This could potentially eliminate some of the errors that are associated with trying to relay information over the phone between parties who are busy, possibly rushed and most likely multi-tasking. Furthermore, this interaction might be capable of assisting both the physician's office as well as the service provider's office with following up on various aspects of the appointment, including confirmation that the patient actually attended, the requested tests/consults were done, as well as applicable reports being completed, sent to, received, and reviewed at the referring physicians office.

3.1.3 External Appointment Follow-up

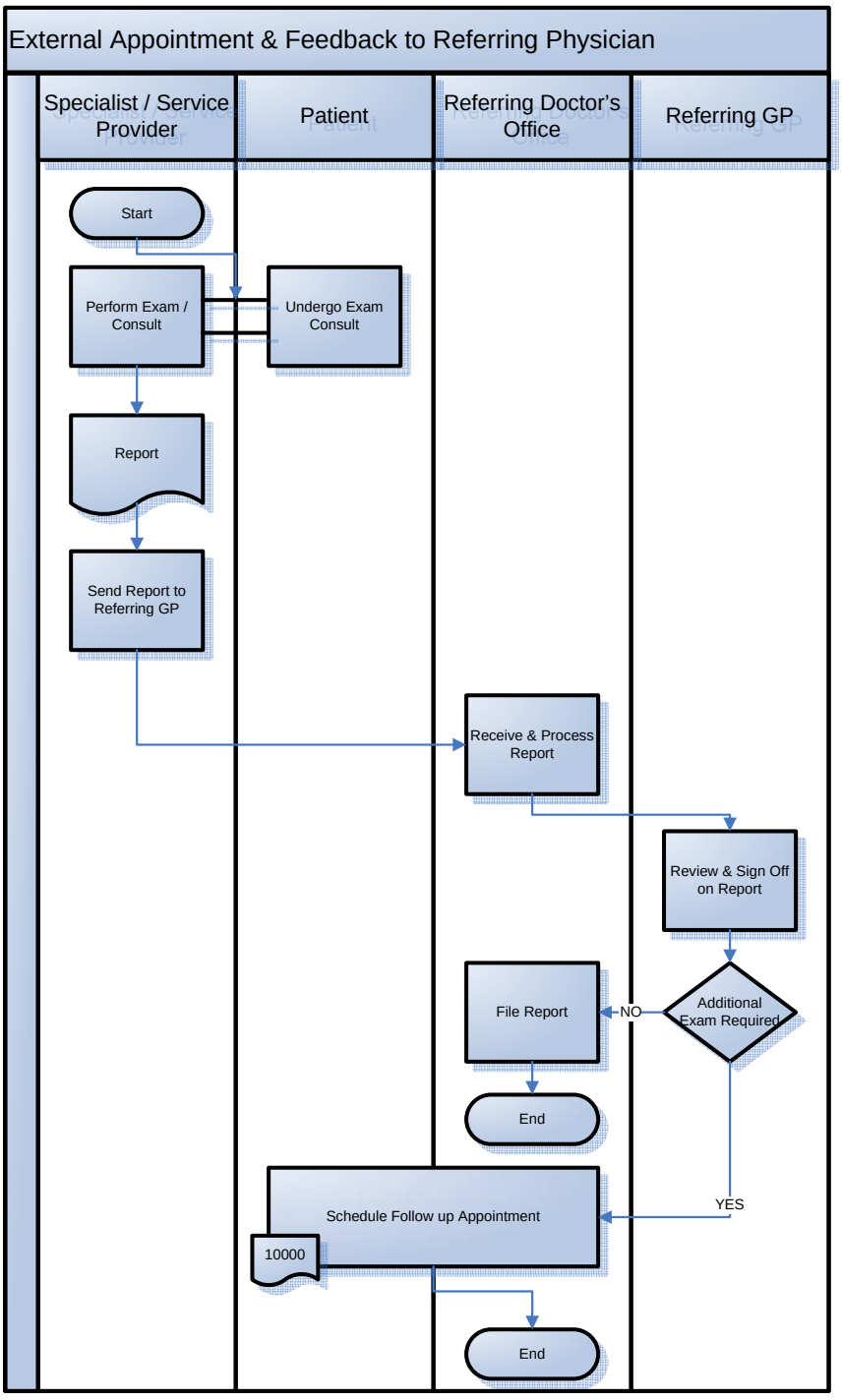

Figure 5 - External Appointment Follow-up Flowchart[19]

[19] created by author

Figure 5 above outlines the workflows for following up on external appointments. Some external sites, but not all, will notify the referring physician's office if the patient did not show up. If the patient does not show up, and notification is not provided to the referring physician, then the referring physician is unaware as to the status of the external exam. After a patient undergoes an exam or test at an external service provider, a preliminary and/or final report is created and sent over to the referring physician's office. The referring physician will then review the report and determine if any follow up action with the patient is required. After the physician has signed off on the report, it is filed in the patient's file. The potential complications and hassles of dealing with couriered documents or faxes are obvious: they can go missing or get mixed up with other documents. The advantage of being able to transmit, review and file records electronically would be extremely valuable to both the service providers as well as the referring physician. This would also facilitate the ability to obtain confirmation that the reports have been completed, sent and received; thus reducing potential legal liability and ensuring that appropriate follow up steps are taken.

3.2 External Lab Exam / Imaging Tests

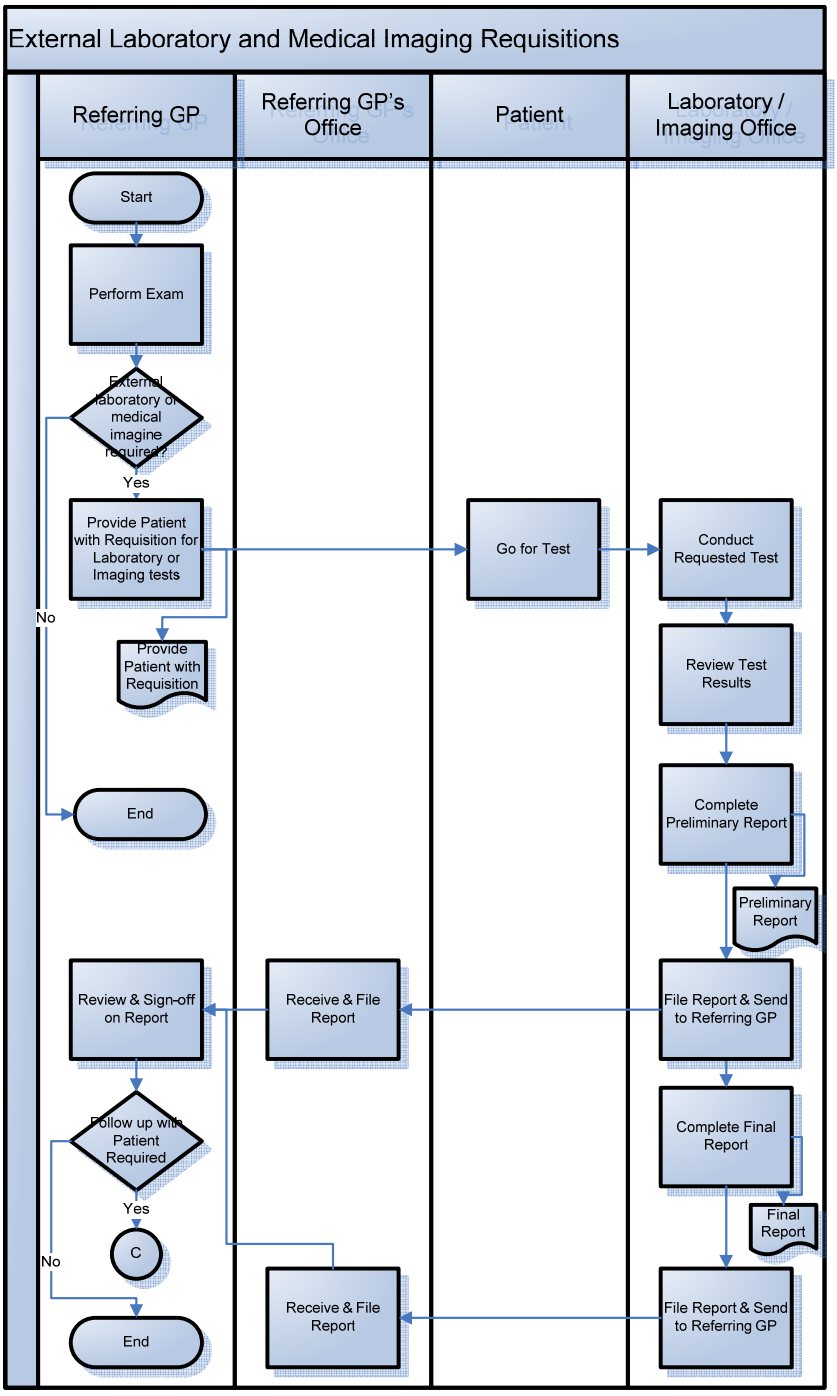

Figure 6 - Flowchart for External Laboratory and Medical Imaging Tests[20]

[20] created by author

As illustrated in Figure 6, often during a patient's appointment the physician notices something potentially abnormal and requests that the patient undergo some sort of laboratory test or medical imaging. The physician will provide the patient with a requisition in order to get the tests done. The majority of these requisitions are paper-based and independent of an EMR, with exception of some laboratory tests. For some medical imaging test (e.g. CT and MRI) the requisition is sent directly to the imaging facility. That facility will then notify the patient with respect to the timing of the appointment. However, the referring physician's office may not be aware of the timing appointment. The patient will then go to one of the numerous laboratory testing or imaging service providers in order to get the test done. Many of the clinics (e.g. medical laboratory and basic x-ray) operate under a walk-in style so the referring physician's office will not be involved in the scheduling of the appointment. More importantly, there are few feedback loops in order to ensure that:

- the patient went to get the test done,
- the test was actually done, and
- preliminary and final reports are completed and sent to the referring physician's office.

The implication of these feedback loops not being closed are discussed in further detail in section 3.3.

Once the tests are done, preliminary and/or final reports are generated and sent to the referring physician's office. The referring physician will review the report and determine if any follow up actions are required. If they are, the patient will be notified

and appropriate actions will be taken. These reports are also filed in the patient's files at both the referring physician's office as well as at the location where the tests were conducted.

3.3 Identification of Feedback loops

In this section, a number of the key feedback loops as listed in Table 5 below will be discussed. There are numerous feedback loops associated with the workflows around current or potential EMR functionality, but the key ones were chosen because of their importance in ensuring that patients receive appropriate care. In addition, the Canada Medical Protective Association (CMPA) in its June 2008 Information*Letter*, highlighted that physicians are responsible for following up on investigations (e.g. radiological lab tests).

Feedback Loops
1. Confirmation that the patient went for the prescribed external appointment/test 2. Confirmation that the tests were actually conducted 3. Confirmation that the preliminary and/or final report(s) have been sent to the referring physician; 4. Confirmation that the referring physician has received and reviewed the report(s) 5. Confirmation that the referring physician has signed off on the report 6. Confirmation that the patient has been notified about the results and if necessary appropriate follow up actions are taken

Table 5 - Identified Feedback Loops[21]

For some appointments, but not all, if a patient does not show up there may be some form of notification sent to the referring GP's practice. In situations where no notification is provided, the referring GP may not be aware that the patient did not go for the prescribed test. Even if the patient attends the appointment, it is possible that the test may not be conducted. For example, if the test requires the patient to fast prior to samples being taken but that patient fails to do so, then the test would need to be postponed.

[21] created by author

Once the tests are done, the service provider will provide a written report to the referring GP. In some situations, there might be a single final report, while in others a preliminary report might precede the final report. Once these reports are written, they are generally faxed or couriered to the GP's office. With some laboratories in B.C. now, lab reports are sent electronically. However, with the current fax/courier systems there are limited feedback loops to confirm that 1) the referring GP's office has received the report and 2) that the referring physician has reviewed and signed off on the report. The objective would be to ensure that the patient has been notified about the results and that follow up actions, if any, are taken in a timely manner.

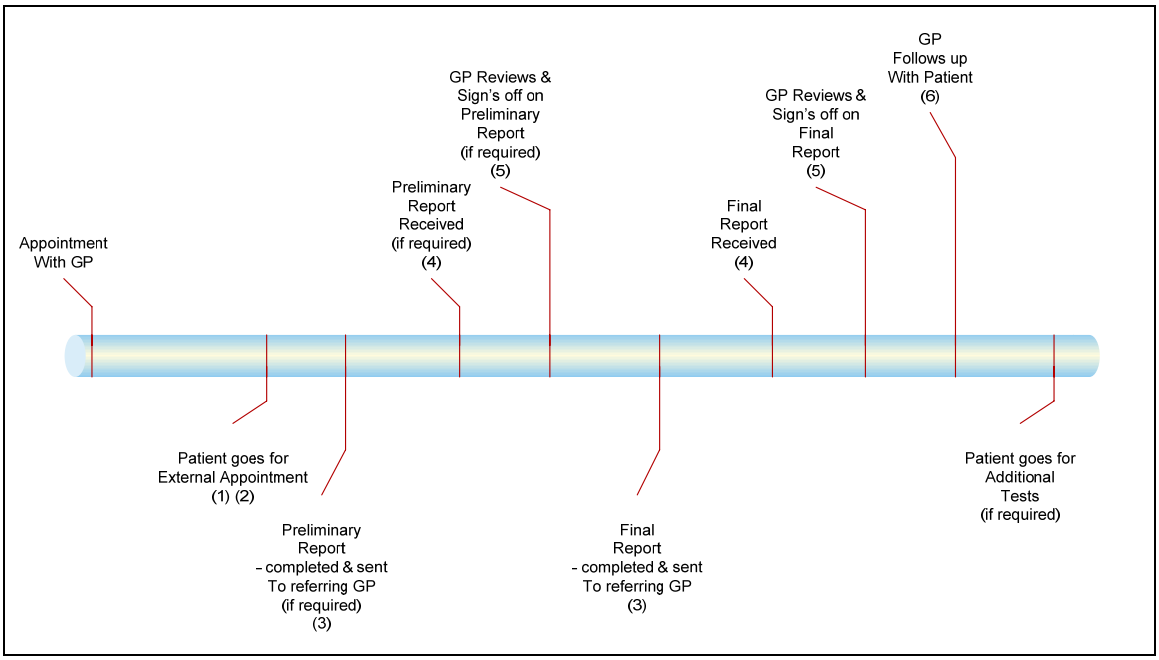

Figure 7 - Timeline of External Service Provider Follow up[22][23]

Due to the large number of patients a physician has, with numerous requisitions provided to patients as well as to service providers daily, it can be extremely difficult for the referring physician's office to track all of the patients at the various stages of getting their external procedures done and reports processed. These stages are depicted in Figure 7, and the corresponding feedback loops are listed in Table 5. The implications of feedback loops not being closed can be extremely serious for the patient, service provider and referring GP. In some situations, this could result in delays in subsequent treatments. These delays may cause treatable conditions to become untreatable conditions and

[22] created by author

[23] Numbers in brackets refer to item numbers in Table 5

therefore resulting in death or a significant decease in the patient's quality of life. In addition, the physician may be legally liable for these negative outcomes.

3.4 Implication of Unclosed Feedback Loops

In the current system, regardless as to whether or not EMRs are utilized or where EMRs are utilized but do not interact with each other, there is substantial risk of feedback loops not being closed. Unclosed feedback loops may potentially result in serious and occasionally life-threatening situations. Unclosed feedback loops may result in a decreased level of patient care, legal liability as well as financial costs as the result of inefficiencies. The implications of unclosed feedback loops will be analyzed from the perspective of patient care, legal liability and financial costs.

3.4.1 Patient Care

When feedback loops are not closed, the level of patient care provided by the practitioner may be lowered and the patient's health may be compromised. However, it is easy to see how these feedback loops are not always closed in the current system. A family physician sees in the range of 30-50 patients per day, which, when multiplied out by a week, then months and over the course of a year, translates to over 10,000 patient visits annually. This makes it exceedingly difficult for a physician's office to track all of the patients who they have referred out for various tests or procedures. Therefore, if an EMR system were to have the capability to track patients, to get confirmation from external service providers as to whether a patient went for the prescribed test, and to ensure that appropriate preliminary and/or final reports are sent and received, it would be extremely advantageous for both physicians and patients.

3.4.2 Legal Liability

The Canadian Medical Protective Association, CMPA, has determined that the referring physician is responsible for follow up of all tests ordered regardless of whether or not they have actually been performed. This in essence mandates that physicians are required to have a 'tickler' system which provides the referring physician with notification to ensure the timely follow up of all tests ordered. If a physician refers a patient for external laboratory testing and the patient decides not to get the test done, there could still be a finding of negligence on the part of the physician by the courts.

In the case of Carlson v. Steeves, Dr. Steeves advised Mr. Carlson to get follow up blood tests done to confirm his previous very high triglyceride levels. Dr. Steeves did not disclose to Mr. Carlson the risk of pancreatitis, a potentially life threatening condition which such markedly high triglyceride levels. Mr. Carlson did not go for the tests nor did he return for complete check-up as requested. Mr. Carlson subsequently developed severe pancreatitis and spent close to eight months in hospital. Had Dr. Steeves had a 'tickler' system, he would have realized that the tests had not been done and would have been able to follow up Mr. Carlson.

An interesting aspect of this case is the fact that feedback loops were not closed, and the physician might not have been aware that the patient did not go back for the additional test. If the feedback loops identified in Table 5 were in place, the quality of care in which physician was able to administer could have improved. The development and utilization of a fully integrated EMR system, which has the appropriate functionality so that notifications or 'ticklers' are provided to referring physicians, this would act to

close these feedback loops. This way, if the patient does not undergo the prescribed tests, the referring physician's office can follow up with the patient.

3.4.3 Financial Costs

There are significant financial costs associated with having someone call service providers in order to follow up on laboratory or imaging results and reports. A fully integrated system would allow physicians' offices to deploy its financial resources in order to increase patient care and to improve their bottom line. People frequently do not think of physician's offices as being businesses, yet they are. In general, it is fairly difficult for a physician's office to increase its top line revenue. Therefore, in order for them to increase their net income, they need to decrease costs, which may result in increased profits. Furthermore, financial costs related to insurance premiums may be reduced with the implementation of appropriate systems that are capable of reducing legal liability. Alternatively, if viewed from an industry perspective, that ability to reduce legal expenses related to medical liability cases could save the industry tens or even hundreds of millions of dollars annually.

3.5 Problem Analysis

In order to illustrate how significant and sometimes fatal errors can occur in a healthcare setting, the swiss cheese model as depicted in Figure 8 can be used. Each slice of cheese, which can be stacked vertically or horizontally, can be likened to a level of human interaction, IT notification or some other 'step' which is put in place in order to mitigate the chances of an adverse event occurring. For example, a set of layers may include service providers completing a preliminary report, sending it to the referring

physician's office, the referring physician's office receiving it and having the physician review and sign-off on it. However, swiss cheese has holes, and these holes are the equivalent of potential weaknesses in the process step. Even with having a step where preliminary reports are drafted and sent to the referring physician, it is possible that the report could be misplaced and/or not sent and therefore subsequent activities could be missed. Therefore, it is possible for each slice to line up in such a way that there is a clear unobstructed hole through all of the slices thus resulting in a potentially serious negative outcome. Therefore, even with all of the protective layers in place, it is still possible for a serious adverse event to occur.

Due to the fact that current electronic or paper based medical record systems are principally independent systems in an industry which is required to share data and records, this results in a number of potential problems or complications. Firstly, data needs to be duplicated within each system when patients move from one physician or service provider to another. When data is entered into a system, there is the inherent risk of data entry errors occurring. Moreover, it also requires resources, which are extremely limited and in high demand to be utilized for data related issues instead of other areas, which may provide greater benefits to patients.

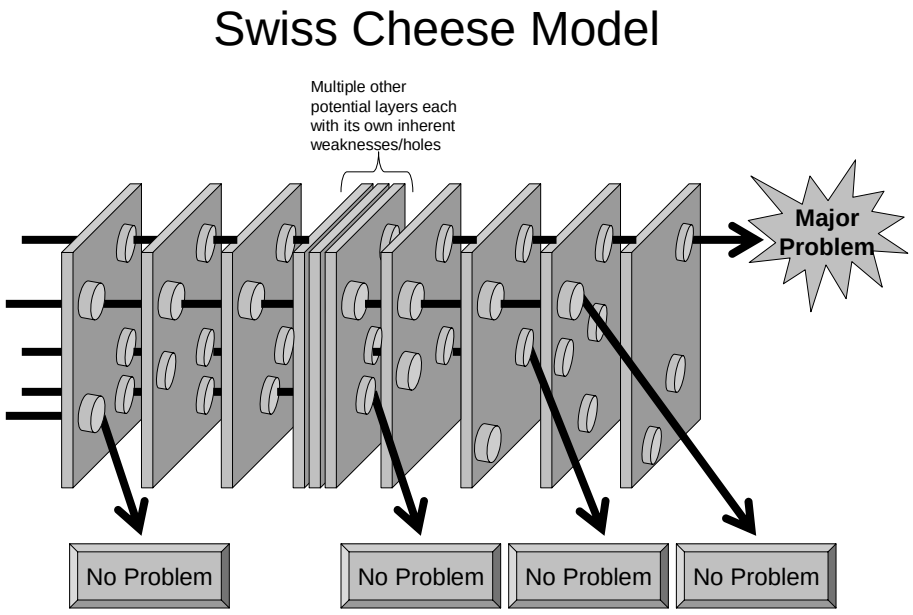

Figure 8 - Swiss Cheese Model[24]

Within the current system, a number of potential weaknesses can be identified and are outlined in Table 6 below. These weaknesses range from issues related to the limited adoption of EMR technologies, to overworked physicians. In addition to the current limitations of EMRs, specifically the limited interaction between systems and different requirement by the various users, it is crucial that feedback loops are closed. This is to ensure that patients receive the appropriate level of care and to minimize the physician's legal liability.

[24] created by author. Modified from Reason J. Human error. In: Latent errors and systems disasters. New York: Cambridge University Press; 1990. p. 173-216

Identifiable Weaknesses within the Current System
• Non-existent or extremely limited automated feedback systems • Overworked physicians and healthcare employees • Limited implementation of EMRs • Limited use of functions within current EMR systems • Limited funding for development of Healthcare Information Technology (HIT) • Limited support for adoption of HIT within primary care facilities • EMRs are relatively expensive investments • EMRs require significant amount of human resources to implement (from all employees within the primary care facility • EMRs require some form of process reengineering within the practice • There are many different users who all need access in order to share data and are using separate independent systems

Table 6 – Identifiable Potential Weaknesses in the System[25]

[25] created by author

4: RECOMMENDATIONS

After analyzing several workflows of small to mid size primary care facilities, it is evident that the utilization of EMRs could significantly assist physicians in mitigating several of the risks associated with unclosed feedback loops. The mitigation of risks associated with unclosed feedback loops will be discussed in section 4.1. The EMRs that are currently available are limited in their functionality and usability, and can be improved upon in several areas. Section 4.2 discusses ways in which EMRs can be improved. As EMRs become more widely used, there are numerous business opportunities available to entrepreneurs, which are discussed in section 4.3. These opportunities range from the development of new EMRs to the development of modules that can be incorporated into current and future EMRs as well as EMR consulting businesses. The consulting businesses could assist physicians with the selection and implementation of appropriate EMR for their facility.

4.1 Mitigation of Risks Identified from Unclosed Feedback Loops

Several risks associated with unclosed feedback loops have already been identified and discussed. It is critical for both physicians and patients that these risks are mitigated. Increased adoption of EMRs, as well as the development of new features within EMRs that would allow different types of users (i.e. different specialists and GPs) to better track patients and test results, could have a significant impact resolving some of these issues. Unclosed feedback loops have the potential to result in serious and even life threatening outcomes. During a conversation with a Physician based in Vancouver, B.C.,

a case was discussed where a patient was sent for an x-ray and some questions were raised based on the initial images. The patient was sent for a different type of x-ray to help clarify the results of the initial x-ray. In the end, the patient decided not to go back for the second x-ray and both the preliminary and final reports of the initial x-ray were not sent to the primary care physician. Some time later the patient returned to the physician who again sent the patient for an x-ray; however, on this x-ray, a terminal disease was noted. It is possible that if the feedback loops were closed when the patient was first sent for x-rays this condition might have been found at a stage where it could have been treated. In this case, as well as many other similar cases, a software system which alerts users of unclosed feedback loops may be able to help mitigate the risks associated with tracking and following up with patients and patient appointments with external service providers. Patient safety and legal liability are two of the main risks that could be mitigated here. However, patient safety and the level of care in which they receive are clearly the more important factors, especially when one considers that if a patient receives better quality medical care, it may save their life!

4.2 EMRs

4.2.1 Increased Adoption of EMRs

Because EMRs have the potential to improve the level of care that patients receive, reduce legal liability, and financially benefit primary healthcare practices, it is plausible that insurance companies, medical associations and government agencies may mandate the use of EMRs. Numerous historical and pending legal cases may also force physicians to adopt EMRs. Due to the risk of legal liability, physicians may be compelled to find suitable ways to overcome the barriers to adoption.

One way to assist physicians with overcoming the barriers is through medical associations, such as the Canadian Medical Association (CMA) or BC Medical Association (BCMA), who could develop a department of consultants. These consultants could help physicians, choose an appropriate system, implement the system, integrate the system into their practice through appropriate training as well to provide support once the system has be integrated. Physicians in general have neither the time nor the expertise to research the numerous systems and then deal with the issues around implementing the system. Therefore, with these consultants, physicians may be more likely and more confident about implementing an EMR system in their practice.

The financial and human resource costs associated with implementing an EMR may be substantial. However, it appears that the benefits of the system with respect to improving patient care and workflows as well as mitigating potential legal liability clearly outweighs both the direct and indirect costs. Unfortunately, it is evident that these benefits are still not enough to convince many physicians to implement EMRs in their practices. This may be because human nature is such that it is uncomfortable with change and prefers inertia; that is change only occurs when external forces are present. This is especially the case in Canada with its aging physician population where many of them are highly resistant to change and do not wish to invest the time and energy in change when they are planning to retire in the near future. As for the direct financial costs related to EMRs, associations such as PITO are helping to mitigate these costs by providing financial support towards the purchase and implementation of EMRs.

Another key barrier to adoption as previously mentioned revolves around the concept of the ‘islands of data’ that are caused by the numerous systems that do not

interact. This is further confounded by the different system and data requirements of the various users (e.g. physicians and specialists). The development of a system or modules that would facilitate the interaction of these different systems, thus allowing the various users and constituents to share data could go a long way toward increasing the adoption of EMRs in the future.

4.2.2 Increased Functionality & Usability of EMRs

As seen with many other forms of information technology, over time the functionality and usability of the technology/system improves to the point where it becomes an integral part of the business and business processes. Email and Blackberries are a great example of a piece of information technology at has become an integral part of day-to-day business. Early EMRs were rather primitive, with very limited functionally. The newer systems have improved on many of the early deficiencies. However, there are still plenty areas which could be improved. One would expect that in the reasonably near future, systems will be developed with the functionality and usability to meet the requirements of the various niche markets, for example medical imaging. In addition, the systems in a medical imaging clinic will be able to fully interact with an EMR in a primary healthcare physician's practice. Again, this does not mean that the medical imaging office would have full access to the patient's medical records from the primary care facility, but rather access to 'appropriate' information that is necessary for the medical imaging clinic. Furthermore, many aspects of the current systems are bulky and difficult to use. Therefore, if the usability of the systems were to improve, this may help facilitate the adoption of EMRs. In this technological age, systems must be easy to use even by non-technologically savvy individuals. The systems must also be accessible

from a range of locations and devices, including workstations, laptops, PDAs and blackberries.

In order to improve the functionality and usability of EMRs significant investments in financial and human resources are needed. Currently there are a large number of companies that are developing EMRs. Therefore, it is conceivable that over time there will be considerable consolidation within the EMR development market. This in turn would give each company a larger share of the market and therefore, greater revenues could be reinvested in product development. The consolidation could also have another effect. With fewer companies, there would be fewer EMR systems for physicians to choose from, and this should make the selection process easier. Furthermore, as these companies grow, one might expect that they would also be able to develop better customer service programs and product updates. This could help to alleviate some of the other barriers to adoption.

4.2.3 Improved Data Access & Data Sharing Across Systems and Users

Another way to increase the adoption of EMRs is through improving the way users access data stored within EMRs as well as how data is shared between systems and users. If practices are able to reallocate resources away from scheduling and entering data into the system (e.g. eliminating a full-time person whose sole job is to scan reports), then practices may be more inclined to invest in an EMR. Furthermore, if the systems are intuitive and easy to use, then the time and resources required for training and adoption into the daily routines of the practice could be reduced. This could help make it easier for physicians to implement an EMR and reducing the associated barriers.

4.3 Opportunities

Potential Business Opportunities
• Development of new Electronic Medical Record Systems • Development of modules to enhance the functionality and usability of current EMRs • Initiation of a consulting business to assist physicians with implementing and maintaining EMRs within their practice

Table 7 - Potential Business Opportunities[26]

There are three main potential business opportunities around the development and implementation of EMRs (Table 7). First, even though there are many companies currently developing EMRs, it is possible for a company to enter the market with a 'better' EMR system. With newer technologies, this system might be easier for primary healthcare practices to overcome some of the barriers associated with adoption. Second, new modules can be developed for use with existing EMRs. Third, many physicians do not have the time or expertise to research and implement EMRs in their practices. Therefore, a consulting business based around helping to identify the key requirements for a practise then selecting and implanting the appropriate EMR system in the practice could be an interesting opportunity. This consulting business needs not be associated

[26] created by author

with a particular EMR company, and may work independently or even for a medical association or the CMPA. With only about 5% of clinics in Canada using EMRs the market potential for each of these three opportunities could be substantial. Furthermore, each of these opportunities is mutually exclusive from one another; thus, further enlarging the overall realm of business opportunities surrounding EMR development, implementation and use.

4.3.1 Development of New EMRs

The EMR market is expected to grow significantly over the next decade. With the market growing, more systems will be implemented. Even though numerous companies are already developing EMRs, no one company appears to have developed the ideal system that is suitable for all or a majority of users. From the discussions with a physician who is currently looking into implementing a new EMR system in his practice, each system that has been reviewed thus far has its own set of inherit strengths and weaknesses. However, the overall result has been disappointing as none of the systems so far provides all of the features that the physician would like to have. The weaknesses in the systems include, but are not limited to, poor user interfaces, unintuitive functionality and limited to non-existent ability to interact with other systems. Therefore, it is possible for new entrants to develop a system better than others that are currently available or under development, and a system that fits a specific niche market; for example, a set of users within a particular geography or healthcare network.

4.3.2 Development of EMR Modules

Thus far, among existing companies not one has emerged as the market leader in the development of EMRs. New players are expected to enter the market by developing new EMRs for at least the near future. When one adds the level of complexity that different users require, there is the potential of another business opportunity. This opportunity would involve the development of modules that could be added on to any EMR system and would facilitate some interaction between the various systems. One technical challenge that would need to be overcome with the development of such modules is that data may be entered and stored differently in the various EMRs.

As the market continues to become fragmented, because of the large number of different EMR systems that are available, the development of modules that facilitate the interaction of different systems could be extremely valuable. This system feature would benefit the physicians, service providers, patients as well as other companies developing different EMRs. These modules might be capable of directly booking appointments at service providers, and transferring basic patient information required by the service providers, for example, MSP numbers and basic contact information. More importantly, the modules might close feedback loops that previously were at risk for not being closed. The potential opportunities for the development of EMR modules are extensive as numerous applications can be added on to an EMR system. For example, if one looks at Microsoft's Excel program, countless add-ons are available for specific applications such as for financial and stock analyses developed by third parties. Therefore, it is conceivable that a similar market environment is created where modules or add-ons could

be developed for specific applications in order to meet the needs of certain users who require additional functionality.

4.3.3 EMR Consulting Business

Physicians are extremely busy and their primary focus should be on providing the highest level of care possible to their patients. Moreover, many physicians are not experts in healthcare information technology or EMRs and simply do not have the time to become experts. Therefore, there is an opportunity for consulting businesses that focus on EMR selection and implementation. There currently are a number of companies that assist physicians with researching, comparing and selecting EMRs. One such company is CanadianEMR. However, there is still a significant opportunity for the initiation of other companies. The size and timing of this opportunity is evident by the fact that only a small percentage of physicians currently use some form of EMRs. In addition, "[t]he American Academy of Family Practice has asserted that the effective use of information technology is essential for the provision of high quality care in the increasingly complex healthcare field" (Gans *et al*, 2005). Therefore, a significant number of physicians should be looking into implementing EMRs in their practices in the near future, and they could use the assistance of an EMR consulting company.

This opportunity could be centred on consultants who are EMR implementation experts. These consultants, along with physicians, identify the key features that the physicians require and then suggest a particular system for them. Once a system has been selected, the consultants would then assist with implementing the system and provide training for all of the users within the practice. This could help mitigate the potential disturbances to the day-to-day activities of the practice as well as smooth the transition to

the new workflow processes associated with the utilization of an EMR. This training component and future support could be the key to creating a consulting business, as one of the barriers to adoption is the change in workflows that are associated with the implementation of an EMR system. Currently, many EMR companies do not have offices or representatives that can immediately respond to and resolve issues in person. Therefore, many physicians will find it advantageous to have a support representative or a company that could respond promptly in order to resolve any problems they face. This would be one of the main reasons why a physician's office wants to hire an EMR consulting company.

4.4 Concluding Remarks

It is astonishing to learn from the literature review that the adoption rate of EMRs in North America is appalling, despite the fact that EMR technology has tremendous benefits that would improve the quality of medical care. One might traditionally think that North Americans are usually on the leading edge of technological innovation and adoption. Yet, for some reasons, Canada and the US are fighting to be the slowest adopters of EMRs (http://www.canadianemr.com). I do not believe that it is question of whether medical practices will adopt and implement EMRs, but rather a question of when. The 'when' factor may be significantly influenced by government ministries and medical associations that ultimately make electronic billing mandatory in Canada.

This study shows that EMRs can have significant benefits for both physicians and patients. However, physicians need assistance to adopt EMRs. Human nature is such that it desires familiarity in life, which results in inertia, rather than venturing into the unknown and unfamiliar. Implementing EMRs takes many out of their comfort area as it

is something new that they must learn to use, and something that requires them to modify their behaviours and workflows. Therefore, government ministries, medical associations and businesses must help mitigate the barriers associated with the adoption and support physicians who implement EMRs in their practices. In addition, these organizations need to facilitate the development of better next-generation EMRs with increased usability and functionality.

The Canadian government, along with medical associations in both Canada and U.S., appear to be advocates and supporters of the adoption of EMRs. They could play an important role in encouraging the industry to develop EMRs that are capable of developing healthcare information technology suitable for a broad range of users and facilities. Clearly, EMRs are becoming a critical component of healthcare information technology. Therefore, as EMRs are implemented, physicians, primary care facilities, patients and entrepreneurs should wreak the benefits of the utilization of such systems.

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