12-16-2020 1:00 PM

Regional Integration: Physician Perceptions on Electronic Medical Record Use and Impact in South West Ontario

Sadiq Raji, *The University of Western Ontario*

Supervisor: Gibson, Candace J., *The University of Western Ontario*
: Ajiferuke, Isola, *The University of Western Ontario*
: Terry, Amanda L., *The University of Western Ontario*

A thesis submitted in partial fulfillment of the requirements for the Doctor of Philosophy degree in Health Information Science

Abstract

Regional initiatives in the health care context in Canada are typically organized and administered along geographic boundaries or operational units. Regional integration of Electronic Medical Records (EMR) has been continuing across Canadian provinces in recent years, yet the use and impact of regionally integrated EMRs are not routinely assessed and questions remain about their impact on and use in physicians' practices. Are stated goals of simplifying connections and sharing of electronic health information collected and managed by many health services providers being met? What are physicians' perspectives on the use and impact of regionally integrated EMR? In this thesis, I examined how primary health care and family physicians use electronic medical records and associated electronic health information resources in South West Ontario, the challenges they face in doing so, as well as the impact of an integrated EMR. A mixed methods-grounded theory research approach was employed to explore physician EMR use, and data acquired using participant consultation, observership and shadowing, semi-structured interviews, and a self-administered questionnaire. The study revealed that there are clear and present challenges to regional integration of EMR. Although regional integration initiatives such as implementation of ClinicalConnect, a regional EMR clinical viewer, continue to expand, physicians face challenges related to implementation, support and advanced use of electronic records. Not every patient has data access, patient portals are often not fully integrated, and the impact of EMR transitioning can reshape a primary care physician practice. A comprehensive model of physician integrated EMR use and a six-stage maturity model were developed from this study: The comprehensive model conceptualizes how the experience of EMR transitioning, managing patient expectation, meeting information needs, engaging regional entities, support and practice context, influence physician perception of EMR integration, and often resulted in practice changing moments. It further describes influences on physician perception of EMR use by EMR offering, EMR content, integration tools, information attributes, practice type, and patient and physician characteristics. The six-stage maturity model provides a framework that describes key elements of operative EMR use within the context of regional integration of electronic health information resources. It enhances understanding of EMR maturity by shifting orientation from theoretical evolutionary improvement path, which

characterized prior maturity models, to assessment of EMR maturity based on how practicing physicians actually use EMR in primary health care. Insights from this study will advance understanding of regional integration of electronic medical records and serve as additional resource for individuals interested in assessment of the use and impact of electronic health information resources in primary health care.

Lay Summary

In this thesis, I examined how primary health care and family physicians use electronic medical records and associated electronic health information resources in South West Ontario, the challenges they face in doing so, as well as the impact of an integrated EMR. A mixed methods-grounded theory research approach was employed to explore physician EMR use, and data acquired using participant consultation, observership and shadowing, semi-structured interviews, and a self-administered questionnaire. The study revealed that there are clear and present challenges to regional integration of EMR. Although regional integration initiatives such as implementation of ClinicalConnect, a regional EMR clinical viewer, continue to expand, physicians face challenges related to implementation, support and advanced use of electronic records. Not every patient has data access, patient portals are often not fully integrated, and the impact of EMR transitioning can reshape a primary care physician practice. A comprehensive model of physician integrated EMR use and a six-stage maturity model were developed from this study: The comprehensive model conceptualizes how the experience of EMR transitioning, managing patient expectation, meeting information needs, engaging regional entities, support and practice context, influence physician perception of EMR integration, and often resulted in practice changing moments. It further describes influences on physician perception of EMR use by EMR offering, EMR content, integration tools, information attributes, practice type, and patient and physician characteristics. The six-stage maturity model provides a framework that describes key elements of operative EMR use within the context of regional integration of electronic health information resources. It enhances understanding of EMR maturity by shifting orientation from theoretical evolutionary improvement path, which characterized prior maturity models, to assessment of EMR maturity based on how practicing physicians actually use EMR in primary health care. Insights from this study will advance understanding of regional integration of electronic medical records and serve as additional resource for individuals interested in assessment of the use and impact of electronic health information resources in primary health care.

Keywords

Electronic Medical Record (EMR), Regional Integration, Primary Health Care, Physician Experiences, Southwest Ontario, Maturity Model, ClinicalConnect, EMR Use, EMR Integration

Acknowledgments

I would like to thank all my professors, colleagues, family and friends. This research would not have been possible without their support and encouragement.

I am particularly grateful to my thesis supervisor, Dr. Candace Gibson for her continued advice, guidance, and support throughout this research process. It has been an honor and a pleasure to work with her. Her sustained openness to my ideas helped in expanding my intellectual horizons about the thesis research area and the field of health information science. This study was supported in part by funds from Schulich School of Medicine & Dentistry to Dr. Gibson.

Special thanks to members of my advisory committee: Dr. Isola Ajiferuke (Faculty of Information and Media Studies, Western University), Dr. Amanda Terry (Centre for Studies in Family Medicine, Western University), Dr. George Kim (Schulich School of Medicine and Dentistry, Western University) and Dr. Francis Lau (School of Health Information Science, University of Victoria). I greatly appreciate the time and effort spent reviewing my work and providing constructive criticisms and recommendations that not only helped shape the direction of my research but also enhanced my development as a researcher. Special thanks to members of the thesis examination committee: Dr. Bridget Ryan, Dr. Nicole Haggerty and Dr. Dan Lizotte, of Western University and Dr. Yuri Quintana of Harvard University.

I would like to thank the 101 primary care and family physicians in southwestern Ontario region who participated in this study for sharing their experiences regarding the use and impact of EMR with me. Despite extremely busy schedules, they were very generous with their time and effort in making this research possible.

I would like to convey my gratitude to Soushaynt Kiarasi of the Department of Epidemiology and Biostatistics, the administrative and support staff at the Faculty of Information and Media Studies, Schulich School of Medicine & Dentistry, Faculty of Health Sciences, FIMS Graduate Library and FIMS Computing Services for being more than gracious with their time and assistance which made my time spent on this research proceed as smoothly as I could ever have hoped.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

A	Agree
AB	Alberta
AHS	Alberta Health Services
ANOVA	Analysis of Variance
APA	American Psychological Association
BC	British Columbia
CCAC	Community Care Access Centre
CCMM	Continuity of Care Maturity Model
CFPC	College of Family Physicians of Canada
cGTA	Connecting Greater Toronto Area
CHC	Community Health Center
CHEATS	Clinical Human and organizational Educational Administrative Technical Social
CHI	Canada Health Infoway
CHRIS	Client Health and Related Information System
CIBC	Canadian Imperial Bank of Commerce
CIHI	Canadian Institute for Health Information
CMA	Canadian Medical Association
CME	Continuing Medical Education
CMM	Capability Maturity Model

CMMI	Capability Maturity Model Integration
CN	Conceptual Notes
CNA	Canadian Nurses Association
cNEO	Connecting North East Ontario
COACH	Canadian Organization for the Advancement of Computers in Health
COPD	Chronic Obstructive Pulmonary Disease
CPP	Cumulative Patient Profile
cSWO	Connecting South West Ontario
D	Disagree
D&MISSM	DeLone and MacLean Information System Success Model
DELPHI	Deliver Primary Healthcare Information
DF	Degrees of Freedom
DSM-V	Diagnostic and Statistical Manual of Mental Disorders – Version 5
EHR	Electronic Health Record
EMR	Electronic Medical Record
EMRAE	Electronic Medical Record Access and Experience
EMRAM	Electronic Medical Record Adoption Model
ENCODE-FM	Electronic Nomenclature and Classification of Disorders and Encounters for Family Medicine
EPR	Electronic Patient Record
FHO	Family Health Organization

FIMS	Faculty of Information and Media Studies
HIMSS	Healthcare Information and Management Systems Society
HOT Fit	Human Organizational and Technology Fit
HRM	Hospital Report Manager
IBM	SPSS International Business Machine Statistical Package for the Social Sciences
ICD	International Classification of Diseases
ICPC	International Classification of Primary Care
ICTC	Information and Communications Technology Council
IDC	International Data Corporation
IMM	Interoperability Maturity Model
IOM	Institute of Medicine
KMO	Kaiser-Meyer-Olkin
LHIN	LOCAL Health Integration Network
MB	Manitoba
MN	Methodological Notes
MOHLTC	Ministry of Health and Long-Term Care
N	Neither Agree Nor Disagree
NB	New Brunswick
NEHTA	National Electronic Health Transition Authority
NHS	National Health Service

NL	Newfoundland and Labrador
NPC	National Products Council
NS	Nova Scotia
OHIH	Office of Health and Information Highway
OLIS	Ontario Laboratories Information System
ON	Ontario
ON	Observation Notes
OTN	Ontario Telemedicine Network
PACS	Picture Archiving and Communication System
PCA	Principal Components Analysis
PDF	Portable Document Format
PMH	Patients Medical Home
PN	Personal Notes
PRISM	Performance Routine Information System Management
PSWO	(Primary Care) Physician in South West Ontario
QC	Quebec
SA	Strongly Agree
SAS	Statistical Analytical System
SD	Strongly Disagree

SK	Saskatchewan
SNOMED CT	Systematized Nomenclature of Medicine for Clinical Terms
SWO	South West Ontario
TN	Theoretical Notes
UMM	Usability Maturity Model
WHO	World Health Organization

List of Appendices

Chapter 1

1 Introduction

The Canadian health information landscape has evolved over several years from the time when medical records, largely paper-based, were the sole responsibility of a single physician or health facility, to the development of new models of electronic health information flow, standardization and use with multiple user and uses. In recent years, implementation of Electronic Medical Record (EMR) has been increasing in Canada (Borycki et al., 2013; Collier, 2015; Gagnon et al., 2010; Price et al., 2013a; Rozenblum et al., 2011a), yet Canada lags behind several countries in the use of EMRs (Canadian Institute for Health Information, 2016; Hertle & Stock, 2015; The Commonwealth Fund, 2012, 2015). A 2015 Commonwealth Fund study estimated that use of EMR has more than doubled from 37% to 73% since 2009 among primary care physicians, but Canada performed below the international average (88%). The study found that Canadian doctors were less likely to make full use of EMRs to manage care and population health, and EMRs were less often used in Canada to support quality of care decisions (The Commonwealth Fund, 2015). Canadian primary care doctors were considerably less likely than doctors in other countries to routinely review surveys on patient satisfaction and patient experiences (17% versus 47%) or to compare their performance with that of other primary care practices (17% versus 37%) (The Commonwealth Fund, 2015).

Additionally, studies have found a relatively small body of literature focused on EMR in primary health care and highlight the need to develop a stronger evidence base to bolster understanding of the use of EMR in primary care settings (Glanville et al., 2011; Owens, 2018; Terry et al., 2012). The experience of EMR use among primary care and family physicians is often not adequately reflected in research nor are patterns of interaction with technology among physicians and patients, or how such interactions are interwoven with the requirement of care delivery from the physician's perspectives.

1.1 Background

As my research effort began to focus on exploring the use and impact use of electronic medical records in primary health care, my initial thoughts on the topic focused on exploring conceptual, historical, theoretical, and methodological topics related to electronic health information generally, and EMR in primary health care, in particular. In this section, I provide background information on eHealth and EMR, primary health care information, and the study context of South West Ontario.

1.1.1 eHealth

The term eHealth is a common neologism lacking precise definition. Several definitions of the term have been published, each providing a unique perspective to understanding and interpreting the term (Oh et al., 2005). While the World Health Organization's Global Observatory for eHealth simply defined it as the use of information and communication technologies for health (World Health Organization, 2011), the term originally arose at the same time as similar terms such as e-commerce and e-trade which mostly commercial or business settings. Eysenbach's (2001) significance in defining it with ten attributes placed it well beyond the simple commercial or business context and extended the description of eHealth beyond characterization simply as 'electronic health'. eHealth was defined by Eysenbach (2001, p. 1) as follows:

> eHealth is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology.

Eysenbach identified ten Es of eHealth – efficiency, enhancing quality, evidence based, empowerment, encouragement, education, enabling, extending the scope of health, equity and ethic (Eysenbach, 2001). Inclusion of the ten Es in the definition provides opportunities to incorporate diverse and critical approaches to analyzing the concept of eHealth. For example, equity is a central concept in health determinants because access to services needed to improve and maintain health is often undermined by the presence of avoidable and remediable differences among groups of people, whether those groups are defined socially, economically, demographically or geographically. The concept of eHealth offers opportunities to develop a better understanding of ways to harness the power of information and communication technologies to reach underserved populations, improve quality and access to health information and health care, and improve overall quality of health systems.

The concept of eHealth continues to evolve as computing and information technologies evolve, and as research into the impact of such technologies on health care increases. Borrelli and Ritterband (2015) described eHealth "as the use of information technology, including the Internet, digital gaming, virtual reality, and robotics, in the promotion, prevention, treatment, and maintenance of health" (p.1205). The evolution of mobile technologies in health or mHealth refers to "mobile and wireless applications, including text messaging, apps, wearable devices, remote sensing, and the use of social media such as Facebook and Twitter, in the delivery of health-related services" (p. 1205). These two areas tend to be used as umbrella terms for the explosion of research currently being conducted at the intersection of information and communication technology and health (Borrelli & Ritterband, 2015). Several studies have identified information and communication trends related to eHealth (Chang & Gupta, 2015; Elbert et al., 2014;

Fogel & Sarin, 2017; ICTC Information and Communications Technology Council, 2009; Misha Kay et al., 2011; Pagliari, 2007; Rubel et al., 2005; Steele Gray et al., 2014; Wyatt & Sullivan, 2005). For example, Kreps and Neuhauser (2010) described such trends as "communication revolution brewing in modern healthcare" (p.329), stressing that despite the great promise to increase patient and care provider access to relevant health information, enhance quality of care, reduce errors, increase collaboration and encourage adoption of healthy behaviors, there is an equally great responsibility to design interoperable, easy to use, engaging and accessible tools to convey the right information necessary to make health care decisions and promote health in diverse populations (Kreps & Neuhauser, 2010; Neuhauser et al., 2013).

Moreover, a wide range of patient populations, from premature infants to older adults have been targeted by eHealth interventions to mitigate common ailments from neonatal to geriatric problems including functional abilities, mobility and sleep, and such interventions may include embedded or wearable technologies applicable to home health care for the frail and infirm (Alwan & Felder, 2008; Bateman & Keefe, 2016; Gund et al., 2013; Philip et al., 2015). Yet, there is some recognition of the limits of technology in health. For example, Batement & Keefe (2016) stated that eHealth cannot replace human interaction and caring but instead should provide a "supportive framework" (p.120) to facilitate comprehensive patient care. Beyond chronic care for neonates and the elderly, eHealth interventions have been applied to diabetes care (Schiaffini et al., 2016), chronic conditions (Duplaga, 2015), rehabilitative and cardiac care (Frederix et al., 2015), wound care (Moore et al., 2015), managing COPD (van der Heijden et al., 2013), tuberculosis (Falzon et al., 2015) and other ailments. Despite several studies on application of eHealth interventions to patients, studies examining physician's perspectives on eHealth are scarce, and where studies were available, they were generally done with physicians in hospital settings, seldom in primary or community care.

1.1.2 Defining the concept of regional integration

For the purpose of this thesis, integration refers to the extent to which health information is linked and exchanged to address primary health care challenges, coordinate care processes and workflows, and deliver primary health care and related services. Regional integration refers to the process in which stakeholder organizations such as primary health care organizations and regional entities combine efforts to improve health information linkages and exchanges within a region. A regionally integrated EMR refers to an electronic medical record with features and capabilities to link and exchange health information to address primary health care needs and coordinate processes, workflows and delivery of primary health care and related services within a region. A review of the meaning and evolution of the concept of regional integration is presented in Section 2.2.

1.1.3 Regionally Integrated Electronic Medical Record

According to Canada Health Infoway, Electronic Medical Record (EMR) refers to an “office-based system that enables a health care professional such as a family doctor to record the information during a patient’s visit”(Canada Health Infoway, 2018, para. 2), it represents the record under the custodianship of the health care provider that holds a portion of relevant health information about a person over the person’s lifetime. The history of EMR can be traced back to the time where medical records were the responsibility of physicians and were merely clinical notations, incomplete and without standardized medical vocabulary or diagnostic testing results(Zitner et al., 2008).

In Canada, the development of new digital health information infrastructure began with the recommendations of the Federal Government’s Information Highway Advisory Council (1997) calling for new information technology applications for the health sector (Health Canada, 2012a). The Office of Health and Information Highway (OHIH) was established in 1997 with the strategic orientation of knowledge development, partnership and collaboration culminating in the eventual creation of Canada Health Infoway Inc. in 2001, an organization tasked with accelerating the development of electronic health records, common health information standards nationwide, and increasing development of telehealth applications, critical to health care in rural and remote areas of Canada (Health Canada, 2012). In Ontario, the Smart

Systems for Health Agency was created in 2003 as an arms-length agency of the Ministry of Health and Long-Term Care with a mandate to provide a secure, integrated information infrastructure for health care providers in Ontario (Smart Systems for Health Agency, 2005). This organization was later reorganized and morphed into eHealth Ontario.

Beyond historical evolution, literature shows the existence of multiple research traditions with different underlying philosophical assumptions and methodological approaches to electronic medical records (Greenhalgh et al., 2009). A number of studies consider the electronic medical record as a tool, having inherent properties that will perform certain tasks and, with proper implementation, will predictably improve the process and outcome of a clinical interaction. Other studies see the electronic medical record as a social construction whose meaning and purpose are a matter of interpretation with constantly changing contexts (Greenhalgh et al., 2009). In essence, philosophical and methodological tensions between positivist and non-positivist traditions exist in EMR studies in particular, and health information research, in general. Development of theories and models to support better understanding of creation, design, implementation, use and impact of EMRs might be approached in terms of the interplay between different philosophical and methodological traditions. While highlighting the importance of theory in development, opportunities and challenges in EMR and eHealth research has led some researchers to call for adherence to highest standards of research design and methodologic rigor to improve the overall quality of eHealth research(Ahern, 2007; Hesse & Shneiderman, 2007).

From the point of view of individual physician clinics and offices, hospitals and health care systems, the EMR is primarily a tool for clinical use. As with the paper record, the EMR represents not only a patient record, but also a legal record that plays an important role not only in care delivery but also in proper billing or funding. From a patient's point of view, the EMR may contain only a portion of electronic health information available about them on the continuum of care while an electronic health record may include information derived from care provided from multiple sites and multiple providers along the continuum within a community, region or province. Integration is therefore pertinent to enhancing the sharing of such health information because sharing clinical data can potentially improve patient safety, care coordination, quality of care, and efficiency.

1.1.4 Primary health care

Primary health care settings usually are the first and main point of contact for patients with the health care system. Primary care was defined by the Institute of Medicine (1994) as "the provision of integrated, accessible health care services by clinicians who are accountable for addressing a large majority of personal health needs, developing a sustained partnership with patients, and practicing in the context of family and community”(Institute of Medicine, 1994, para. 1). Health Canada defined primary health care as an approach to health and a range of services beyond the traditional health care system with the dual function of direct provision of first-contact services and coordination of continuity across the continuum of care (Health Canada, 2012b). Primary health care services typically include prevention and treatment of common diseases and injuries, basic emergency services, primary mental health care, healthy child development, maternal care and rehabilitation services, among others (Health Canada, 2012b). Types of care typically involve routine care, nutrition counseling, end-of life care, liaison with home care, health promotion and disease prevention (Canadian Institute for Health Information, 2014). Starfield (1998) considered orientation toward family and community health as fundamental to primary care. The terms primary care and primary health care are often used interchangeably and have been described both as an approach to health services delivery and as a philosophy of health care aimed at providing a range of services beyond the traditional health care system. For example, Canadian Nurses Association noted that in contrast to primary health care approach, primary care refers to the first line clinical services that provide an entry point to the health care system (Canadian Nurses Association, 2005), while princples such as accessibility, public participation, health promotion, appropriate technology and intersectoral cooperation encapsulate primary care approach. (Canadian Nurses Association, 2003).

Primary health care physicians differ in a few ways from other physicians such as internists, paediatricians and physicians working in psychiatry. For example, the foundations of Family Medicine were built on clinical medicine, epidemiology, human behavior and human development (McWhinney, 1969), yet changing patterns of disease have unique implications for primary care physicians working in the community who often play the role of a primary, continuing and personal physician to patients. All key relationships in primary care – with patients, with primary care providers' colleagues in practices, in the wider health services and local communities are underpinned by basic, core values passed down through tradition (McWhinney, 1998). The tradition is predicated on the four principles of family medicine which state that the family physician is a skilled clinician, family medicine is a community-based discipline, the family physician is a resource to a defined practice population and that the patient-physician relationship is central to the role of the family physician (College of Family Physicians of Canada, 1986). The four concepts have evolved into what the College of Family Physicians of Canada (2011) developed into a vision for Canada encapsulated in *Family Practice: The Patient's Medical Home*. The Patient's Medical Home (PMH) refers to "a family practice defined by its patients as the place they feel most comfortable – most at home- to disuss their personal, family health and medical concerns" (College of Family Physicians of Canada, 2011, p. 8). The development of specialized electronic health information resources, and adoption and use of electronic medical records in primary care can potentially enable improved care processes and communication in support of primary care initiatives such as the Patient's Medical Home in order to nurture key primary care relationships, not only to meet the needs and expectations of patients and physicians, but also of health systems in various jurisdictions. Updated in 2019, the PMH document included references to electronic records and identified EMRs as a pillar infrastructure necessary to facilitate delivery of timely, accessible and comprehensive care (Lemire, 2019). The advantages of electronic health information over paper records are clear, noteworthy and widely accepted. However, despite investments in primary care renewal in various jurisdictions across Canada, a sustainable, comprehensive, national primary health care information strategy is lacking. Patients, primary health care providers, and decision makers need high quality primary health care information to support patient care, performance measurement and quality improvement. Various stakeholders are interested in measures to track access, quality and cost in primary care, but the absence of seamless flow and use of primary health care information, coupled with lack of comparable, consistent data over time and across jurisdictions often render this difficult.

Primary health care practices in Ontario deliver services covering areas of health promotion, disease prevention as well as disease treatment and management. Several primary care and family medicine models exist in Ontario with unique compositions and service delivery characteristiscs as shown in Table 1 below (Ontario Ministry of Health and Long Term Care, n.d.).

Primary Care Practice Model	**Characteristics**
Comprehensive Care Model	**Designed for solo primary care physicians** **Regular office hours plus one 3-hr session of extended hours (weekday evenings and/or weekends)**
Family Health Groups	**3 or more physicians practicing together – not necessarily in the same office space but in close proximity** **Nurse-staffed, after-hours Telephone Health Advisory Service provides advice to enrolled patients**
Family Health Networks	**3 or more physicians working together as a group – not necessarily in the same office space but in close proximity. May add allied health professionals** **Nurse-staffed, after-hours Telephone Health Advisory Service provides advice to enrolled patients** **Sign governance and Family Health Networks agreements to join**
Family Health Organizations	**3 or more physicians work together as a group – not necessarily in the same office space but in close proximity. May include allied health professionals** **Nurse-staffed, after-hours Telephone Health Advisory Service provides advice to enrolled patients** **Sign governance and Family Health Organization agreements to join**
Family Health Teams	**Work in interdisciplinary teams** **Regular and extended hours** **Become a member of a primary care group affiliated with an existing Family Health Team to join**
Rural-Northern Physician Group Agreement	**Serves rural and northern communities with a complement of 1-7 physicians** **Nurse-staffed, after-hours Telephone Health Advisory Service provides advice to enrolled patients**
Community Health Centers	**Interdisciplinary teams serve hard-to-serve communities and populations that may have trouble securing health services** **Centers focus on addressing the underlying conditions that affect people's health, such as social determinants of health, poor diet and literacy**

Primary Care Practice Model	Characteristics
	Regular and extended hours **Physicians are salaried employees of the Community Health Centre**

Table 1. Primary care and family practice models in Ontario

Source : http://www.health.gov.on.ca/en/pro/programs/pcpm/

1.1.5 Study location: South West Ontario

South West Ontario is a region of Southern Ontario encompassing most of Ontario peninsula bordering Lake Huron, including Georgian Bay, on the northern and northwestern part; the St. Clair River, Lake St. Clair, and Detroit River, on the western part; and Lake Erie to the south (Bone, 2017). The eastern part of Southwestern Ontario shares border with Central Ontario and the Golden Horseshoe (Bone, 2017). The region had a population of 2,583,544 in 2016 (Statistics Canada, 2016), the largest cities, in order of population (2016), are: London (population 383,822) , Kitchener (population 233,222), Windsor (population 217,188), Guelph (population 131,794), Cambridge (population 129,920), Waterloo (population 104,986) , Brantford (population 97,496), Sarnia (population 71,594), St.Thomas (population 41,813) , Woodstock (population 40,902), and Stratford (population 31,465) (Statistics Canada, 2016). Prior to dissolution in 2019 (Payne, 2019), Local Health Integration Networks or LHINs were mandated to plan, integrate and distribute provincial funding for all public health care services at the regional level. Created in 2007, LHINs were the result of government of Ontario's reform initiative established as locally based organizations with additional purpose of enhancing engagement among various health services providers and communities in the regions (Gardner, 2006). South West Ontario region was subdivided into four LHINS which acted as health authorities and administrative units responsible for regional administration of public health care services in the province of Ontario (Haq et al., 2015). As shown in Figure 1, based on numbers from the Canadian medical directory, there were approximately 3,439 primary health care and family practice physicians in the region by LHIN (512 in Erie St. Claire, 1193 in Haldimand Brant, 1020 in South West, and 714 in Waterloo-Wellington), (Scott's Directories, 2016).

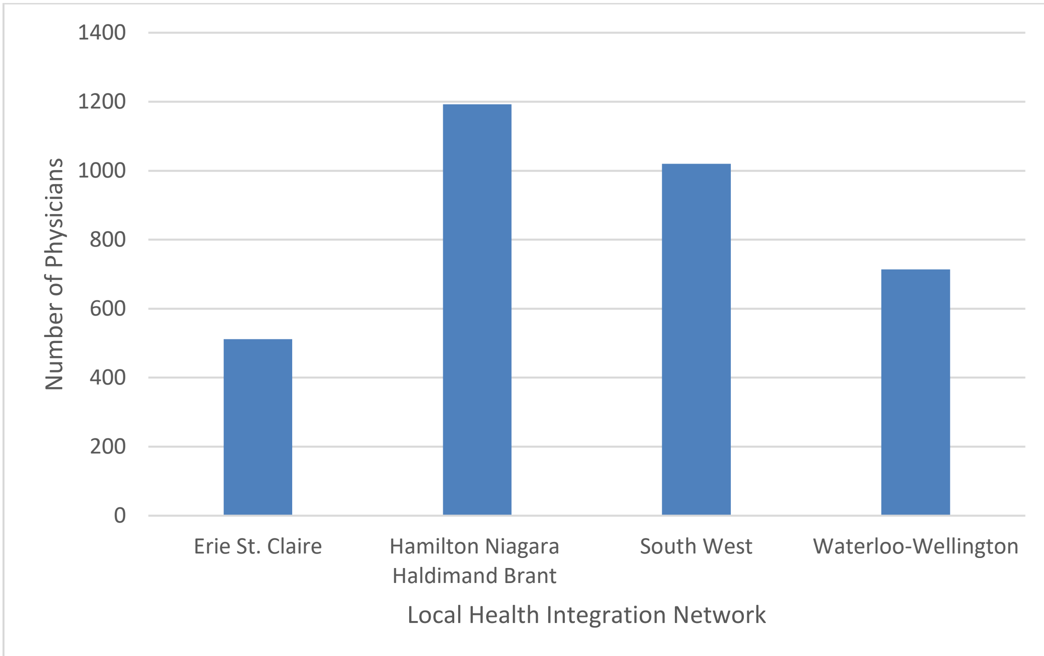

Figure 1. Primary care and family physicians in Southwestern Ontario by Local Health Integration Network, 2016.

Source: Canadian Medical Directory, 2016

The region represented one of three hubs for eHealth programs tasked with delivering provincial health record services in Ontario (eHealth Ontario, 2016). As with other eHealth clusters in Ontario, Connecting South West Ontario or cSWO program stemmed from *Ontario's Action Plan for Health Care* (Government of Ontario, 2012) which called for support for Ontarians to become healthier through faster access and stronger link to family health care under the banner of "the right care, at the right time, in the right place".

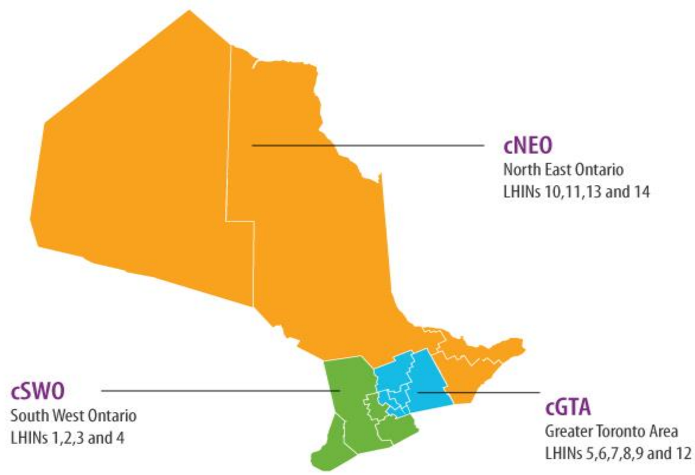

Figure 2. Ontario Regional eHealth Hubs (eHealth Ontario, 2014)

Source: (eHealth Ontario, 2014)
https://www.ehealthontario.on.ca/images/uploads/pages/documents/Blueprint_Book.pdf

According to eHealth Ontario (2016), the cSWO program was designed to deliver rapid clinical value and benefit by leveraging existing assets and integrating electronic health information available in the region. cSWO oversaw an integrated electronic health record (EHR) and implementation of a regional clinical viewer (ClinicalConnect) integrated with local and provincial information sources, as well as a number of related services, such as data support, adoption and change management, project management, privacy management and policy development. The program involved more than 2,000 health service providers and 40,000 health care professionals, serving 3.6 million residents in south west Ontario or approximately 30 per cent of Ontario's population (eHealth Ontario, 2016).

1.2 Research problem

A broad research lacuna currently exists on the use and impact of regional integration of EMRs as pertains to primary health care. In addition to addressing research gaps, the goal of this thesis is to gain conceptual and real world understanding of the experience of regional integration of EMR in a specific regional setting. Challenges stemming from adoption, use and impact of electronic medical records in South West Ontario form an integral part of broader challenges related to service delivery in health care in the region and are often associated with availability and access to pertinent health information. Primary health care organizations and service providers in the region are realizing that challenges related to proper management and coordination of care delivery are equally related to limitations of ready availability of health information and the necessary technology infrastructure and its management. The evolution of health care delivery processes and the changes experienced during implementation, adoption and use of new health information resources/technologies lead to new research problems. In this thesis, I identify two important reasons for the research gaps: inadequate user perspective on use and impact of regionally integrated EMR, and inadequacy of current models and frameworks in addressing unique study contexts.

1.2.1 Inadequate user perspectives on use and impact of regionally integrated EMR

Regional integration of electronic medical records is an important but poorly understood aspect of development, adoption and use of EMRs, both in Canada and internationally. Studies of EMR integration have mainly focused on interoperability and health information exchanges without adequate attention paid to regional integration and maturity levels of EMRs (Adenuga et al., 2015; Gaynor et al., 2014; Kierkegaard, 2015; Kuo et al., 2011). Few studies have used in-depth qualitative and quantitative methods that can empirically reveal the complexity of the process of regional integration and EMR use by considering all possible contextual and situational factors that may facilitate or constrain physicians when they deliver care using information technology as enablers. Primary health care practitioners and family physicians are often left out of research involving integration and maturity of EMRs despite the expanding role of health information technologies, increasing use of health data and the legal and ethical implications of access to and privacy of health information in primary care. It is often difficult to find professionals and researchers with expert knowledge of health data origins, quality, linkages, proper use and maintenance in regional settings such as Southwest Ontario. Accordingly, input of primary health care professionals such as family physicians and family health teams on the use, impact, benefits and drawbacks of electronic medical records in the region provides necessary insight into new health information systems and maturity of currently used health information tools such as EMRs. Studies examining factors associated with integration of electronic medical records with available regional integration tools are scarce, particularly in such settings as southwestern Ontario. Even more scarce are studies that address maturity levels of EMR users. Although some studies have investigated electronic health technologies in regional settings, most have focused on application and effects of benefits evaluation models in a regional setting (Alexander et al., 2017; Francis Lau et al., 2007b). Systematic analyses of physician perspectives on the use and impact of regional integration of electronic medical records are rarely completed in South West Ontario.

The reasons for this research gap remain unclear. A possible barrier to filling this research and knowledge gap may be the continued presence of limited understanding of the EMR and its potential contribution to the delivery of health care at the regional level. Some support exists for this contention (Anderson, 2007a; Hsieh, 2014; Francis Lau et al., 2012; R. H. Miller & Sim, 2004; Zimmerman, 2010). The Commonwealth Fund (2015) report indicated EMR use among Canadian primary care physicians continues to increase, but the use of advanced functions that support improved patient care varies. Some of these functions dependent on an integrated systems include transfer of information from hospitals to family practices, information exchange between and among family practices, transfer of information from family practices to specialists, etc.

Furthermore, it is possible that primary health care physicians encounter difficulties while using EMRs, do not have or see the value of developing the skill set necessary to use advanced functions, and may not have the time and resources to adequately determine the value of using EMR at more advanced levels or determine maturity level of EMR use in their practice. While EMR implementations increase, EMRs may be underutilized and their impact under researched or inadequately reported.

1.2.2 Inadequacy of current models and frameworks in addressing unique study context

Integration of electronic health information resources should be viewed as part of health care processes and management. However, integration of EMR in primary health care is a challenge. This is because there are so many partners and stakeholders involved in management and delivery of care. Several frameworks and models of evaluation exist, yet they are frequently constrained and limited by underlying philosophy, theory and assumptions (Brender, 2006a) which often provide basis for their influences, focus, configurations or scope. Evaluations can be specific to a domain, or seek to answer questions from a technical, sociological, economic, human and organizational or combination of these points of view (Yusof, Kuljis, et al., 2008a; Yusof, Papazafeiropoulou, et al., 2008). Therefore, in applying a framework, the domain and area of interest must be known to enable effective and useful application of the framework's theory and underlying assumptions.

As discussed earlier, regional health information organizations are multi-stakeholder organizations working together to connect health care communities with the goal of improving quality of care, the health and safety of individuals, and the efficiency of health care systems. Connecting regional health care through information does not however merely refer to simple or consistent messages sent out by one area of the health care system to all stakeholders in the region, but incorporates contextually unified purpose, strategies and activities for an integrated EMR. Ultimately, integration refers to every primary health care information flow and use activity in the region. Consequently, integration is a region wide pursuit, and not a quick fix solution to transfer or exchange of health information. As a result, it can be argued that models and frameworks examining integrated EMRs should thus address integration from a region-wide perspective.

Regional integration is an inevitable, evolutionary product of continued implementation and proliferation of the EMR. Hence, reference is made in this review to literature dealing with evaluation frameworks and maturity models for information and communications technologies in health care. There is not a single framework or model to address all the numerous questions and perspectives brought into a health care process, differences in types of healthcare organizations, their purposes, stakeholders and interests will influence both the focus of evaluation and the framework (Yu, 2010). Primary care organizations need to consider pertinent questions when embarking on the journey of integration: Why do you want to integrate information? What is the information going to be used for? What kind of information technologies and tools to employ? Answers to these questions will help unpack prior assumptions on the stakeholder's goals for the integration and provide guidance on the suitable framework for routine assessment of integration efforts. This is because initial assumptions and stakeholders' purposes are significant influences on the object, content, tools and direction of integration. In a review of evaluation frameworks for health information systems, researchers found complementary frameworks despite differences in underlying assumptions of each framework and of how the frameworks were applied (Yusof et al, 2008), which allowed for modification and contextualization.

Majority of frameworks and models examined in this thesis originated either outside of a regional setting or regional integration was not the main focus. There are two reasons for conducting such examination of the models and frameworks. Firstly, most of the works on evaluating electronic health information systems spend virtually little time introducing existing models, although the underlying thinking in the works are often based on existing models. Secondly, examining previous models and frameworks enables better understanding of their potential influence on regionally integrated electronic medical record, which is the focus of this thesis. I argue that the models and frameworks currently used to assess health information systems in health care present several evolutionary stages on the path to an ideal, fully integrated level. This helps organizations and practices that choose to apply those models and frameworks to establish their priorities in adopting, using or redesigning their activities and processes. However, for many of these models and frameworks, other entities or stakeholders than patients are assigned great importance. It is not always clearly evident in several of these models and frameworks (except the Continuity of Care Maturity Model) that patients remain the most important group of stakeholders in any health care delivery setting. Patients' values are not always explicitly mentioned and emphasized.

Furthermore, physicians' views and regional contexts are lacking. The fact that the original models and frameworks are not specifically designed for the users in the region may result in inadequate applicability of the models and frameworks. In essence, there isn't an all-inclusive framework, yet the underlying philosophy, perspective or orientation of a framework determines its usefulness in one context or another. The implication for primary healthcare organizations that wish to incorporate evaluation frameworks and models into their electronic health information or technology plan is to begin the evaluative process prior to implementation and incorporate evaluation at every stage before, during and after implementation. In the context of EMR integration in South Western Ontario, use of integration tools such as ClinicalConnect or Hospital/Health Report Manager, provide new opportunities to explore and evaluate solutions aimed at providing information exchange across disparate health information systems, and the diversity of technology that is in use in any given region.

1.3 Research questions

As has been noted above, existing EMR studies are very important, with findings that are crucial to the advancement of the adoption of EMR as well as for the development of patient population and practitioner educational or training initiatives. However, the importance of understanding the issues from the perspectives of physicians in primary care and family medicine working in the region cannot be over-emphasized. The lack of focus on issues relating to the use and impact of EMR among practitioners in regions across Canada, including South West Ontario represents a significant gap in EMR literature. As a result, in this thesis, the focus will be on examining physicians' perspectives about EMRs as reflected in the research questions below.

- What are the perceptions of primary care and family medicine physicians in South West Ontario about regional integration of the electronic medical record (EMR)?
- How do physicians in primary care and family medicine use regionally integrated EMRs in South West Ontario?
- What are the principal influences on the use of regionally integrated EMRs in South West Ontario?

- How do physicians in primary care and family medicine experience the impact of integrated EMR in South West Ontario?
- What challenges do physicians face in using regionally integrated EMR?

These questions form the basis of examination of the use and impact of electronic medical records South West Ontario. Anecdotal evidence exists to suggest that a clear understanding of regional integration of EMR is limited in terms of its use and impact. These broad research questions were developed into substantive questionnaire and interview items to help elucidate current gaps in knowledge and provide a basis for understanding EMR maturity levels in the region for those who seek to conduct routine assessment of use and impact of regionally integrated EMR. Despite the focus on south-western Ontario, this research is applicable to other regions in Ontario, in Canada and beyond.

1.4 Significance of the thesis

This thesis examined key issues of regional integration of EMRs in the context of primary health care. EMRs are fundamental components of electronic health information infrastructure and resources available for use in primary care, and are gaining increasing importance in light of the critical role they play in supporting delivery of care, particularly in solo and group practice physician offices, family health teams, walk-in clinics, community health centers, community care access centers and hospitals.

Considering many of the concerns regarding needs, adoption, use and impact of electronic health information brought to light by previous studies, it is essential to examine EMR use and impact from the perspective of physician users. This thesis focuses on physicians for a couple of other reasons. First, physicians are trained professionals ultimately responsible for the care of their patients. Therefore, it is essential to have adequate knowledge of how they use available electronic health information resources to deliver the best care possible to patients. Precisely, it is essential not only to have adequate knowledge of the benefits and factors that influence their use of EMRs, but also the barriers or challenges they face in the process. Second, physicians can serve as proxy for understanding patients and patient care. Particularly, those in primary care working in communities and in regions, are a unique demographic because they tend to need and use integrated health information resources to connect patients to pharmacies, labs, or referrals to specialists and other physicians. As a result, they are pertinent to the discussion of an integrated EMR.

The setting of this thesis research at a region that serves as one of the hubs for implementation of province wide integrated health information initiative is important because the region has a significant population base that has been poorly represented with regard to EMR research. In considering the significance of the study, theoretical, methodological and applied considerations are given to the problem of evaluation and determination of maturity of integrated EMRs and ways of examining benefits of EMR to primary care practitioners, organizations and patients in the region. Furthermore, the thesis is significant for the following reasons.

First, the study attempts to explain the current status of EMR use in a regional setting, which is critical to understanding not only the benefits and drawbacks of EMRs, but also (and especially) maturity models and their application to regional settings.

Second, primary health care practitioners were studied with the aim of exploring maturity of integrated electronic health information resources in their practices, and how regional integration enhances or impedes their electronic health information needs and uses. Generalized research or profiles of primary health care practitioners do not always highlight variations by practice, or the specific challenges posed by structural and functional elements of regional integration of electronic health information systems.

Third, the study is not centered on hospital-based electronic health information systems and uses because a shift to primary health care, the first and most frequent point of contact of individuals with the health system is seen as the most important point of contact where novel approaches are needed to enable primary health care delivery. The hospital has been the context from which electronic health information systems have mainly been studied previously. In this study, eHealth benefits (through EMR use and impact) are studied within the context of the work primary health care practitioners do and within the context of their experiences using qualitative and quantitative methods. The study builds on previous research and provides a point of departure for incorporating critical approaches to the study of EMR use and impact using both quantitative and qualitative research methods.

Fourth, a new model of eHealth evaluation incorporating a maturity process specific to primary health care attributes provides a better understanding of the nature of use and impact of electronic health information in primary health care. It also provides empirical evidence to unpack assumptions about the impacts, benefits and drawbacks of integration of EMRs in regional settings. This potentially could serve as a practical framework for future electronic health information evaluations of use and impact.

Finally, key terms defined, key organizations identified, key technologies highlighted, key methodologies applied, and key models developed set the parameters for this study and may be used for comparison with similar and subsequent research that builds on this one.

1.5 Thesis structure

This thesis consists of eight chapters. In the first chapter, background of the thesis is provided along with the rationale and significance of the study. It includes background information about eHealth, EMR, primary health care, and the study context of South West Ontario region. The second chapter reviews key studies in EMR research related to the thesis topic. The review includes a discussion of the broad concept of eHealth as well as relevant literature on EMRs specifically. It includes an analysis of the evolution of the EMR in Canada and in primary health care. The chapter discusses studies on evaluation, evaluation frameworks, maturity models and critical approaches to evaluation. An overview of the concept of primary health care, key organizations pertinent to the study such as Connecting South West Ontario, EMR tools and factors influencing the use of EMRs in primary care were presented.

In the third chapter the research design is presented. It includes explanation of the research paradigm, constructivist epistemology, research methods including mixed methods design, grounded theory and information about the quantitative and qualitative components of the study. This chapter also presents information about data collection, data sources and participants, the questionnaire and interview phases of data collection, observation and shadowing and profile of the participants. Research considerations including ethical and quality considerations were presented. The chapter encompasses data preparation and analysis.

The fourth chapter present the observation and shadowing component of the research. In the fifth and sixth chapters the research results are presented. These chapters include the results of the quantitative and qualitative data analysis. Chapter seven contains the discussion and chapter eight the conclusions and indications for future research. Several appendices containing information relevant to the interview, the questionnaire, coding, along with definition of terms and abbreviations follow the bibliography.

Chapter 2

2 Literature review

In this chapter, I present review of literature on EMR use in primary health care, regional integration, evaluation studies, evaluation frameworks and maturity models.

2.1 EMR use in primary health care

Research suggests that without better information on adoption and use, stakeholders interested in promoting eHealth may not be able to determine what benefits to anticipate from health information technology use (Chaudhry et al., 2006). Researchers, policy makers, health services administrators and other stakeholders require access to better information to determine how best to implement systems in order to maximize value from technology investment, or how to channel policies and programs aimed at improving the quality and efficiency delivered by the primary care sector in particular, and the health care system in general (Chaudhry et al. 2006).

Early research on EMR focused more on adoption than use. Research evidence demonstrates that the most frequent adoption factors common to various groups of users, including users in primary care settings, are design and technical concerns, ease of use, interoperability, privacy and security, costs, productivity, familiarity, skill and ability with information technology, motivation to use new technologies, patient and health professional interaction, lack of time, workload and work processes (McGinn et al., 2011). Primary care user groups identified factors specific to their professional and individual priorities, such as alignment with key primary care attributes related to accessibility, coordination, sustained care, comprehensiveness, partnership with patients, patient-centeredness and care integration (Krist et al., 2014).

Health information technology adoption encompasses clinical information, communication and supporting technology solutions, often observed through the implementation and use of electronic records e.g., EHRs, EPRs, EMRs. The adoption and use of electronic records need to be measured to offer a better understanding of and insight into the value and contribution of those records to improving the healthcare of Canadians and the capability of the healthcare delivery system (COACH Canada's Health Informatics Association, 2013). The evidence further suggests that system design features influence users' adoption of technologies and a mismatch between clinical workflows and information system design and implementation strategy accounted for the inhibition of the systems' adoption (Jaspers et al., 2008; Peute et al., 2010). In essence, how users interact with new technologies within their environments and how they perceive system qualities motivates them in adopting such systems and in achieving the greatest benefits from them. Researchers identified government policy as a factor in use of computer technologies in general practice, especially with regard to accreditation of vendor systems, providing support to GPs, as well as use of communication standards and nomenclatures (Pagliari, 2007; Protti, 2007).

In a systematic review conducted by Lau et al. (2012) to examine the impact of electronic medical records in physician offices, 48 distinct factors were identified that influenced EMR success in areas such as prescribing support, disease management, clinical documentation, work practice, preventive care, and patient-physician interaction. The researcher concluded that there is limited positive EMR impact in the physician office and emphasized the importance of drawing on lessons from previous studies and models. Such lessons include having robust EMR features that support clinical use, redesigning EMR-supported work practices for optimal fit, demonstrating value for money, having realistic expectations on implementation, and engaging patients in the process (Bassi et al., 2012b).

Adoption models of electronic health records provide a way to measure, standardize, assess and report on health information technology utilization and maturity. The EMR Adoption Model or EMRAM of the Healthcare Information Management Systems Society Analytics (HIMSS Analytics, 2009; Powers, 2009) is a popular example of such a model. Various hospitals in Canada have been reporting their level of adoption of Electronic Patient Records (EPRs) in acute care using the EMRAM model since 2009 (COACH Canada's Health Informatics Association, 2013). Primary care providers in some provinces in Canada use various models as a reference to evaluate EMR capability at each adoption level on the model and identify the degree of change and integration necessary in clinical workflows when advancing from one level to the next (COACH, 2013). Examples include the Clinical Value Model in British Columbia, EMR Outcomes Assessment Model in Alberta, and the EMR Maturity Model in Ontario.

Conceptualization of adoption and use of information technologies typically rely on models and frameworks to help make sense of research findings and allow for comparison and alignment to different or future implementation initiatives. Lau, Price and Bassi (2014) developed an adoption framework that takes into consideration contextual factors at micro, meso and macro levels. At the micro level, the quality of the system, measures in terms of technology, functionality, information and support services, can have an impact on its anticipated or actual use and on the real or perceived user satisfaction(Lau et al., 2014). At the meso level, people, organization, and implementation processes can influence benefits of the system, while at the macro level, standards, funding, policy and trends can influence use and by extension, benefits of the system(Lau et al., 2014). The three levels are consistent with the Infoway Benefits Evaluation Framework (Canada Health Infoway, 2012). Other researchers have shown that in order to accelerate adoption, health information technology policy needs to be tightly aligned with major strategic directions of health care reform (Rozenblum et al., 2011b), enable an interactive, incremental management approach to both technology and data standards (Salzberg et al., 2012) and adoption needs to be actively fostered, bottom up, clinical needs first approach, with focus on interoperability, national policy on investments in electronic health records, and financial incentives for adopters (Rozenblum et al., 2011). While these frameworks address adoption and use of information technologies generally, they lack the level of detail necessary to examine the use and impact of regionally integrated EMR from the perspective of primary health care physicians.

To address the gaps identified in literature and evidence on use and impact of EMR in primary health care, this thesis focused on a variety of organizational, people and technical aspects of regional efforts to integrate EMR. The thesis is aimed at shedding light not only on use and impact of EMR, but also barriers faced by primary health care physicians, including those in smaller practices, in their quest to integrate electronic health information through the EMR. EMR and eHealth research are at an early and evolving stage of development in various settings and despite the importance of EMR integration, existing studies focus mainly on investigating organizational impact and business value of health information technologies or development of clinical applications (Cresswell et al., 2013; Middleton et al., 2013).

Studies from the United States show that interest among health care providers is growing, yet challenges remain about use of EMR & EHR(Miller et al., 2015; Newell & David, 2012; Sweet & Moulaison, 2013; Vest & Jasperson, 2010). Studies in Canada have described positive impact on patients, health care providers and the health system. In clinical and primary care settings, electronic health records (EHRs), electronic medical records (EMRs), integrated clinical viewers, etc., all represent prime examples of tools and solutions at various stages of implementation and adoption (Alvarez, 2004; Canada Health Infoway, 2014). In the broader health and healthcare domains, genetic, lifestyle, socio-economic and environmental data represent important areas of efforts to streamline and integrate electronic sources of health information upon which health policy and management decisions can be formulated (Shortliffe & Cimino, 2014).

2.2 Regional integration

Regional integration is a concept commonly used in studies involving political economy or broad socio-political matters related to law, customs, trade, government and technology. Regional integration refers to a process in which neighboring entities such as geographic areas enter into agreements in order to improve cooperation through common institutions and rules (Scheingold & Lindberg, 1971). Studies of regional integration in non-health fields have focused mainly on developing models to address regionally integrated professional communications in areas such as marketing, public relations, government and the environment (Grunig & Grunig, 1998; Mattli, 2012; Mulenga, 2013; Oh & Rugman, 2012; Schiff & Winters, 2003; Schmitter, 1970; Van Gijseghem & Vaughn, 2008)

In order to determine what regional integration means within the specific context of EMRs and in the broad context of eHealth, it is necessary to examine how the term has been used in academic and grey literature. Regional Health Information Systems are described as multi-stakeholder organizations working together to connect health care communities with the goal of improving quality of care, the health and safety of individuals, and the efficiency of public health systems and nations (Mäenpää et al., 2009). Studies on regional integration of electronic health information have investigated different types of regional health systems and technologies with various outcomes (Bourn & Davies, 1996; Cuggia et al., 2006; Fuller, 1997; Hanmer et al., 2007; Protti, 2008; Triska et al., 2005). For example, Triska et al. (2005) examined integration of a health delivery system in three regions of Western Canada provinces and found that perceptions of regional integration varied by organizational culture, and lack of a consistent strategic plan inhibited adequate access to clinical data despite improved coordination and communication and an enabling of multidisciplinary teams. By contrast, studies from Finland (Nykanen & Karimaa, 2006), Denmark (Nøhr et al., 2001) and Austria (Machan et al., 2006) found improved clinical data access, improved clinical data exchange, and support for workflow despite concerns over security and privacy.

Closely related to the idea of electronic health information integration is the concept of interoperability. According to HIMSS, interoperability refers to the extent to which systems and devices can exchange data, and interpret that shared data (HIMSS Health Information and Management Systems Society, 2013). For two or more systems to be interoperable, they must be able to exchange data and subsequently present that data in ways that are understandable to the user. Defined as “the ability of different information technology systems and software applications to communicate, exchange data, and use the information that has been exchanged” (HIMSS Health Information and Management Systems Society, 2013, para. 1), interoperability comprises of three levels referred to as foundational, structural and semantic. Poor interoperability poses obstacles to integration efforts as personal health records, electronic medical records and electronic health records can reside on different systems or platforms under various technologies and standards. These heterogeneous data sources may have different data models, schemas, labelling conventions and extent of details used to represent similar data (Sujansky, 2001).

Regional initiatives in the context of health care in Canada typically involve governance models, such as regional health authorities, used by provincial governments to administer and deliver health care services, organized along geographic boundaries or operational units. Health care in Canada is designated as a provincial responsibility under the separation of powers in Canada's federal system, health care funding and administration decision making are usually done by provinces through operational units governed by provincial health ministries (Marchildon, 2014). Several provinces and territories are organized into regional health authorities. For example, Alberta Health Services was created as a single health authority for the province of Alberta in 2008 from nine former regional health authorities (AHS Alberta Health Services, 2018). In 2006, the province of Ontario enacted the Local Health System Integration (LHIN) Act to provide for an integrated health system to improve the health of Ontarians through better access to high quality health services, coordinated health care in local health systems and across the province, and effective and efficient management of the health system at the local level by local health integration networks (Government of Ontario, 2006). Fourteen LHINs existed in the province at the time of this thesis research (Statistics Canada, 2017).

eHealth Ontario, the provincial agency responsible for managing and facilitating the development of the province's electronic health record system used the term 'regional integration' in its early days to describe the development of three health information hubs under the umbrella name Connecting Ontario (eHealth Ontario, 2016). Regional integration was intended to simplify connection of the electronic health information collected and managed by many health services providers with the information in provincial repositories. The three hubs (connecting Greater Toronto Area (c-GTA), connecting South West Ontario (c-SWO) and connecting Northern and Eastern Ontario (c-NEO) leverage local, regional and provincial assets to connect existing health information technologies aimed at improving clinical and patient care. According to eHealth Ontario, ConnectingGTA represents half of Ontario's population and is comprised of six Local Health Integration Networks (LHINs) – Central, Central East, Central West, Mississauga Halton, North Simcoe Muskoka and Toronto Central (eHealth Ontario, 2016). ConnectingNEO consists of the four northern and eastern LHINs – South East, Champlain, North East and North West covering 20 per cent of the provincial population (eHealth Ontario, 2016). Connecting South West Ontario is the main cluster of focus of this research.

According to the Canadian Medical Association (CMA), approximately 74% of primary care physicians and community-based specialists use EMRs in Canada, and 64.3% of GPs and 60% of specialists use an EMR to enter and retrieve clinical data (Canadian Medical Association, 2014). Data from the 2013 National Physician Survey showed that 74.2% of GPs and the same percentage of specialists have been using some form of EMR for over two years (CMA, 2013). The data did not include regional analysis of the use of EMR in South West Ontario nor provide an analysis of the rationale of non-users of EMR at the regional level. This constitutes one of the several gaps in literature which this thesis aimed to fill.

The Office of Chief Medical Informatics Officer of Ontario reported in its 2015 Benefits Realization Update that in South West Ontario, as of April 2015, 162 clinical sites have access to the regional EMR integrated viewer ClinicalConnect with evidence showing stronger uptake from the Waterloo Wellington LHIN compared to the other three LHINs in the region (Ontario Office of Chief Medical Informatics Officer, 2015). The sites include hospitals, community care access centers, long term care homes, community health organizations, public health units, family health teams and various primary care facilities. Out of the 162 clinical sites, 90 use the Ontario Laboratory Information System (OLIS) through ClinicalConnect. Case studies on the psychosis patient intake process for early referral programs in South West Ontario reveal a reduction in waiting period and elimination in variability in access to care following introduction and use of the ClinicalConnect viewer (Alexander, 2016b). Approximately 128 days of non-treatment were avoided for patients living in psychosis after community providers received proper training on ClinicalConnect (Alexander, 2016a). Despite these reported benefits of ClinicalConnect, no independent study has been conducted to examine the use and impact of ClinicalConnect from the perspective of family physicians and primary health care professionals in the region.

2.3 Evaluation studies

Evaluation is a term typically understood to mean a process of measuring, assessment or making judgment about the amount, number or value of something. Understanding of the concept of evaluation is pertinent to elucidation of the use and impact of a regionally integrated EMR. Some scholars have defined evaluation as the "decisive assessment of defined objects, based on a set of criteria, to solve a given problem" (Ammenwerth et al., 2003, p.126), and for information systems specifically, as the process of describing the implementation of an information resource and judging its merit and worth (Friedman & Wyatt, 2006). There are numerous approaches to evaluation and the process of evaluation is often dependent on rationale, timing, context or complexity. Framing of the context may determine whether a process is construed as evaluation, research or a combination of both. For example, while stressing the importance of context in evaluation, Brender (2006) described evaluation as having no value in itself as it is performed in the context of informing a decision. Research is often aimed at acquisition and generation of new knowledge and has been used to aid in decision making, while evaluation is often applied to develop new knowledge in addition to its application to decision making processes (Alkin & Christie, 2004; Brender, 2006b).

Friedman and Wyatt (2006) provided three discrete definitions adapted from earlier evaluation literature, applicable to the study of EMRs specifically, and health information science or biomedical informatics generally. The first describes evaluation as the systematic application of social science research procedure to judge and improve the way information resources are designed and implemented (Rossi et al., 1999). This definition described evaluation from the perspective of the social sciences and implies that evaluations are planned, orderly endeavors where information generated can result both in the determination of value of an information resource and in its improvement. The second definition defined evaluation as the process of describing the implementation of an information resource(s) and judging its merit and worth (Guba & Lincoln, 1981). This definition is less restrictive with regard to methods of data collection as it recognizes the need for openness to a broad range of methods, including quantitative and qualitative methods. The third definition described evaluation as a process leading to a settled opinion,(House, 1980). Regardless of the definition or the approach, evaluations of health information technologies and systems rely on models and frameworks to help make sense of findings and allow for comparison and alignment to different or future initiatives.

While exploring the rationales for performing evaluations, Friedman and Wyatt (2006) determined at least five major reasons why health information resources are evaluated. Health information systems and technologies are evaluated to “encourage the use of information resources” (p.3) in a promotional sense, in order to encourage and reassure clinicians, patients, researchers and educators that the resources are beneficial. In addition to promotional reasons, evaluation is often conducted for scholarly, pragmatic, ethical and medicolegal reasons. Scholarly reasons for evaluation refer to the idea that some developers and researchers conduct evaluations as a scientific endeavor or for discovery purposes. Additional factors shape evaluation studies into different study types that are likely to appeal to different stakeholders. From needs assessment to design validation to usability and impact evaluations, the broad questions asked in each study type may be dependent on the audience or stakeholders primarily interested in the results (Friedman and Wyatt 2006).

2.3.1 Evaluation frameworks

Evaluations of health information technologies and systems rely on models and frameworks to help make sense of findings and allow for comparison and alignment to different or future implementation initiatives. Frameworks and models are constantly evolving. While the contents and visual components of a framework can enhance the ability to conceptualize, visualize and apply it, the underlying theories forming the basis of the framework can be complex and wide-ranging. Health information scientists need to regularly review, and where necessary, redefine key evaluation models and frameworks, compare them for strengths and weaknesses, and assess their responsiveness to the continuously changing health information landscape. This section presents a summary of some of the key models or frameworks used in evaluating health information technologies and systems, provides assessment of their strengths and weaknesses, explores the rationale for their use, and the implications for organizations that wish to incorporate evaluation models or frameworks into their health information technology plan.

Seven frameworks and models reviewed in this analysis are the DeLone and Maclean Information Systems Success Model, Canada Health Infoway Benefits Evaluation Framework, World Health Organization Health Metrics Network Framework, eHealth Value Framework, CHEATS Framework, PRISM Framework and HOTFit model

2.3.1.1 DeLone and Maclean Information Systems Success Model

The DeLone and Maclean Information System Success Model has its origins in the 1949 framework proposed by Shannon and Weaver which focused on the technical and semantic quality of information that is transmitted, along with its influence, meaningfulness or effectiveness (DeLone & McLean, 1992). Although the D&M IS

Success Model was developed for computerized information systems, due to its origin in Shannon and Weaver's general framework for assessing information processes with emphasis on the value of communication, it can also be used as a general information systems framework.

Shannon and Weaver (1949)	**Measurement Questions**	**D&M IS Success Model**
Technical	How accurate and efficient is the system?	System Quality
Semantic	How well is the intended meaning conveyed?	Information Quality
Influence	What is the value of the information to the receiver?	Use User Satisfaction Individual Impacts Organizational Impacts

Table 2. Alignment between Shannon and Weaver's Framework and D&M IS Success Model (DeLone and Maclean, 1992)

The model modifies three independent components and interconnects them into six components or interdependent dimensions namely; systems quality, information quality, and use, user satisfaction, individual and organizational impact (Table 2).

Application of this model is strengthened by the relationships between and among its dimensions and can be applied not only to validate the model's characteristics, but also establish the magnitude of interdependencies and relationships between and among the components. The model was designed to reflect the interdependent or process nature of information system success (DeLone & Maclean, 1992). Challenges to the initial model prompted modifications to include a service quality measurement and a combination of the impact measures to express net benefits of the system which identifies impact of the system beyond the user and include the impact on any connected entities such as the organization and the society (DeLone & McLean, 2003). The D&M IS Success Model has been adopted, applied and used with measurement indicators of system quality (ease of use, functionality, reliability, flexibility, data quality, integration, portability, importance), information quality (accuracy, timeliness, completeness, relevance, consistency), use (frequency of use, time of use, usage patterns, number of access, dependency), user satisfaction, organizational impact and individual impact (DeLone & McLean, 2003).

The strength of this model lies in the relational interconnectedness of its components. In practice, the model allows researchers and evaluators to apply both quantitative and qualitative modes of inquiry to fulfil data requirements (Yu, 2010). A mixed methodology approach makes it adaptable extensively in evaluating information system effectiveness and holds a promise in assessing the effectiveness of web-based applications. The weaknesses of this model are lack of capacity to assess contextual factors of an infostructure and an inadequate coverage of factors associated with system failure (Van Der Meijden et al., 2003). These weaknesses have led to efforts to combine the model with other evaluation frameworks. For example, the HOT-fit evaluation framework incorporated the D&M IS Success Model and was developed to address some of the weaknesses of the model (Yusof, Kuljis, et al., 2008b; Yusof, Papazafeiropoulou, et al., 2008).

2.3.1.2 CHEATS Framework

Limitations of traditional models, approaches and frameworks and the absence of organizational impact in older evaluation frameworks prompted the development of CHEATS, representing clinical, human and organizational, educational, administrative, technological and social aspects of evaluation of health information and communication systems(Shaw, 2002). It was designed to represent the multidimensional impact of utilization of technology in health care and address the gaps of traditional evaluation approaches (Shaw, 2002). The traditional approaches that form the basis of the CHEATS framework are applicable to other healthcare areas such as medications but require modification to perform well in health information and communications technology evaluations. The clinical components assess impact on quality of care, diagnosing and continuity of care measures to address how technology supports the physician in providing care, and how technology influences the practice environment, workflow and attitudes (Shaw, 2002). For example, the framework can examine the impact of technology on referral rates, patient and physician attitudes. The human and organizational aspects examine changes in interaction and collaboration styles within the organization and how technology impacts on patient-provider interaction (Shaw, 2002). Educational factors highlight the benefits of knowledge and skill acquisition to professional development, as well as the context of educational initiatives. The administrative domain emphasizes influence of computerization on data collection and scheduling, assessing benefits for patients and providers through improved access. It also includes cost analysis and funding decision support. Technical, social and systems integration components are incorporated (Shaw, 2002).

The limitation of this framework lies in the extended range of areas of focus, which makes it virtually impossible to address every aspect of information technology implementation. The recommended use of both qualitative and quantitative methods has the potential of addressing some of the challenges posed by the large scope of technical, human and organizational factors in the framework. However, a reassessment of the factors is needed to specify areas of inclusion more clearly and make the framework better applicable to real world situations involving health information technology evaluation, especially if the framework were to be applied to regional settings.

2.3.1.3 WHO Health Metrics Network Framework

The Health Metrics Network Framework by the World Health Organization was designed as an assessment tool to evaluate the functioning of national health information systems, to examine health information and statistical accuracy of captured health data, and determine how captured information supports the productivity of the health sector (Health Metrics Network, 2008; WHO (World Health Organization), 2008). The six principles of the framework were health information system resources, indicators, data sources, data management, information products, dissemination, and use. It included 197 predesigned questions with capacity for modification to accommodate local variations. It was a quantitative measurement scheme with responses scored on a Likert scale from 0 (not adequate at all) to 3 (highly adequate), intended for use as an integral part of larger consultative, collaborative and development processes for countries and aims to support national health information systems to meet the standards of functionality as outlined in the framework, along with ongoing efforts to inform on countries’ progress in meeting set goals (Health Metrics Network, 2008; WHO (World Health Organization), 2008).

One of the strengths of this framework was its emphasis on the role of stakeholders representing a wide range and various levels of interest. The framework enables stakeholders to track progress of the country by acquiring comprehensive feedback that is adaptable to each country's needs over extended periods of time. Its weaknesses include impracticality in providing comparative analyses between countries and the length of time required for detailed and extended approaches to data collection and analyses. Another strength of the framework was its inclusion of an evaluation of national data sources which can be used to assess validity and timeliness of data, especially from less economically developed countries. This, however, can also limit its capacity for use as a yardstick for country comparisons making it difficult to guarantee 100% accuracy of information provided. Moreover, the tool does not show how results gathered are linked or connected to other aspects of health information systems.

2.3.1.4 Canada Health Infoway Benefits Evaluation Framework

The Canada Health Infoway Benefits Evaluation Framework was developed to provide a guiding framework for evaluation of health information systems in Canada, primarily for projects sponsored through Canada Health Infoway (Lau, Hagens and Muttit, 2007), and to provide insight about achievement of goals related to information system quality, access and productivity (Canada Health Infoway, 2007). The framework was developed based on the principles of the D&M IS Success model and employs six dimensions of the model along with measurement areas incorporated based on the findings of Van de Meijen (2003) and additional evidence from the literature (Lau et al., 2007a). One of the significant characteristics of this framework is its emphasis on relationships among the measures, retaining the relational significance resulting from the influence of D&M IS Model.

The framework consists of 20 evaluation measures covering areas of system quality, information quality, service quality, use, user satisfaction, quality, access and productivity (Canada Health Infoway, 2007). The set of measures related to technical components of system quality assess functionality, performance and security features. Information needed to gather data related to these measures can be derived from system design diagrams, system logs and observational studies. Information quality measures examine content and availability measures related to data flow and data use qualities such as accuracy, completeness, consistency, timeliness and interpretability. These involve assessment of individual data elements to determine that contents are representative of the results of the system's processes (Canada Health Infoway, 2007). Details about measures and appropriate data collection mechanisms related to other components of the model such as service quality use, user satisfaction, quality, access and productivity, as well as specific guidance for evaluation of laboratory, drugs, public health, telehealth and interoperable electronic health record systems, are available in a technical report accessible through the Canada Health Infoway Website: www.infoway-inforoute.ca

One of the limitations of the Infoway's Benefits Evaluation framework is the lack of attention paid to socio-organizational and contextual factors. In order to address this limitation, Lau (2009) proposed an extension that includes an addition of two levels of assessment as intermediate layers with dimensions for people, organization, network and implementation, as well as an external level encompassing the role of technology standards, professional practice, funding and incentives, and legislation and policy (Lau, 2009). In a review of systematic studies on health information system studies, Lau, Kuzeimsky, Price & Gardner (2010) identified 39 additional metrics in 7 categories not included in the Infoway Benefits Framework. This illustrates both a limitation regarding coverage or comprehensiveness of the framework, and potential for extension of the framework to address missing components (Lau et al., 2010). Given that the benefits framework was designed for use at a national scale, keeping the framework simple to aid application across various jurisdictions and organizations needs to be balanced with the need for comprehensiveness and wide coverage of indicators.

2.3.1.5 eHealth Value Framework

The eHealth Value Framework (Lau, Price & Bassi, 2014) provides a basis for emphasizing and describing the influence of dynamic interactions of complex sets of contextual factors at micro, meso and macro adoption levels on eHealth values. Also known as the eHealth Value Framework for Clinical Adoption and Meaningful Use, the framework was developed from a combination of features of previous models, including Infoway Benefits Evaluation Framework, HIMSS EMR Adoption Model, Clinical Adoption Framework and Meaningful Use Criteria, among others, in order to provide a comprehensive view of eHealth and the value of eHealth (Lau, Price and Bassi, 2014). The framework emphasizes investment (direct and indirect), micro factors influencing adoption such as system quality, information quality and service quality, use and user satisfaction, building on the strength of interrelatedness of these factors from predecessor models. The framework includes meso level factors of adoption such as people, organization and implementation, as well as macro factors such as standards, funding, policy, governance and trends. Value components of care processes, health outcomes and economic returns are measured against productivity, access and quality (Lau et al., 2014).

One of the strengths of the framework is the recognition and inclusion of a temporal component representing adoption and impact lag times, acknowledging the impact of time to implement and realize benefits on eHealth adoption. The framework provides a basis for assessing regional or jurisdictional eHealth adoption and is applicable nationally and internationally to inform policy improvements related to eHealth implementation and adoption. The progression from measures of investment through adoption to value provides benchmarks for achievement and descriptors for eHealth adoption at each stage. Despite its strengths and novelty, validity of the framework has to be established. Moreover, the iterative nature of the adoption process from micro through meso and macro levels is not evident as policy makers may be more inclined to apply the framework through funding, standardization and government policy channels before attending to factors related to service, system or information quality. It is also difficult to ascertain how eHealth adopters who are removed from policy circles, such as primary care physicians practicing in local settings, can apply the model without having specific guiding questions or measurement criteria for each component of the framework.

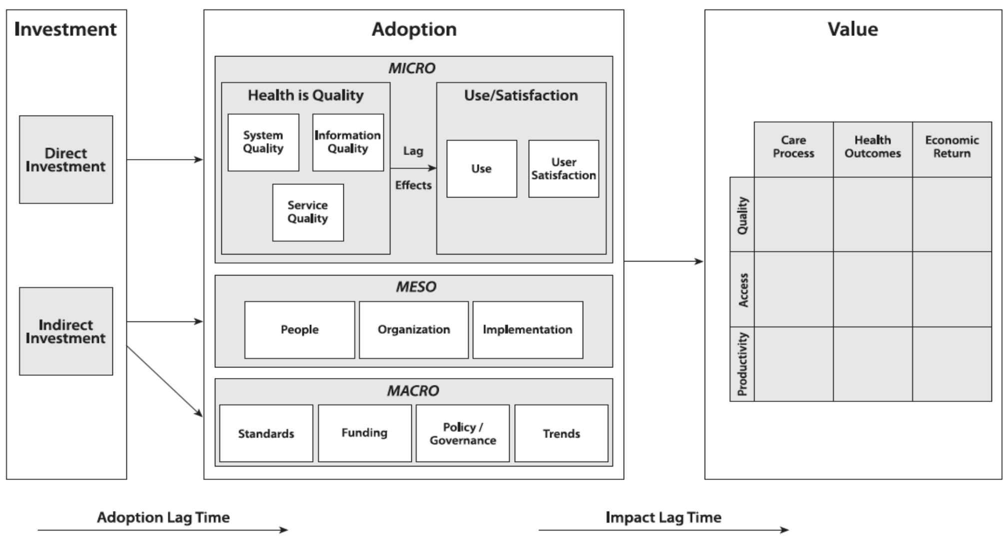

Figure 3. eHealth Value Framework for Clinical Adoption and Meaningful Use (Bassi, Lau & Price, 2014)

2.3.1.6 PRISM Framework

PRISM stands for Performance Routine Information System Management. It is a framework intended as a contribution to the task of large scale evaluations that focus on the internal performance of health management information systems (Aqil, Lippeveld and Hozumi, 2009). The framework was developed on the premise that technical, organizational and behavioural factors represent determinants of performance, and performance is considered a characteristic of health management information systems. Performance is influenced and impacted by processes. Likewise, processes are directly or indirectly influenced and impacted by technical, organizational and behavioral factors (Figure 4).

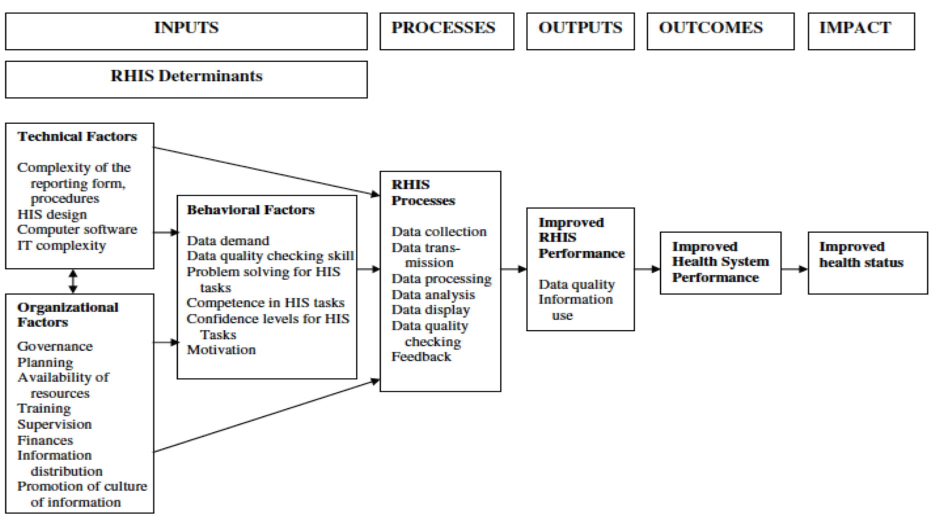

Figure 4. Performance of Routine Information System Management (PRISM) Framework (Aqil, Hozumi & Lippeveld, 2009)

Similar to the DeLone and Maclean model, there is interaction or influence between and among the factors themselves. For example, technical and behavioral factors can influence each other, or they can influence organizational factors individually or collectively. The framework is target oriented. By identifying a goal and linking its achievement to factors of processes, the framework makes it less onerous to identify factors that negatively impact on performance (Aqil, Lippeveld & Hozumi, 2009).

The PRISM framework identifies and selects its areas of focus by limiting its range only to routine health information system functions, primarily service delivery and resource management. In practice, the tool is administered through a performance diagnostic mechanism consisting of four component tools: 1) the Routine Health Information System Performance Diagnostic tool, 2) the Routine Health Information System Overview tool, 3) the Routine Health Information Management Assessment tool, and 4) the Organizational and Behavioral Assessment tool (Aqil et al., 2009).

The Prism evaluation framework and its component tools provide useful support for monitoring the performance of an organization with focus on the internal processes. However, such focus limits the performance of the framework within its operating environment due to lack of regard, attention or consideration for external factors that may impact on the organization. System and framework modifications and improvement may be necessary to address factors external to an organization sometimes having equal or greater influence than internal processes.

High level of convergence among the four parent adoption models is a strength, indicating that many EMRs will provide the same functionalities and deliver necessary value to physicians and patients. It provides an opportunity for future modification, standardization and inclusion of enhanced features. A weakness of this model is its inability to reflect EMR adoption levels independently, without reliance on surveys which may not always be collected and reported in a timely fashion. It is possible that some hospitals and physician practices will demonstrate higher capabilities in certain areas of EMR adoption than in other areas, making it challenging to determine accurate adoption levels.

2.3.1.7 HOT-Fit Model

This research will build on previous evaluation studies and appraise the applicability of frameworks currently in use, such as the HOT Fit framework (Yusof, Kuljis, Papazafeiropoulou, Stergioulas, 2008), to regional integration of electronic health information systems.

The HOT-fit (Human, Organization and Technology-fit) was built on earlier models of information systems evaluation, particularly the Information Systems Success Model and the IT-Organization Fit Model. The framework was validated using a case study of a Fundus Imaging System (FIS) of a primary care organization in the UK and a qualitative systematic review of fifty-five case studies. It identifies and highlights the following dominant adoption factors: technology (ease of use, system usefulness, system flexibility, time efficiency, information accessibility and relevancy); human (user training, user perception, user roles, user skills, clarity of system purpose, user involvement); organization (leadership and support, clinical process, user involvement, internal communication, inter organizational system, as well as the fit between them.

The framework was built on the DeLone and Maclean (1992) model of information system success based on three independent components with interconnection on six interdependent dimensions namely; systems quality, information quality, and use, user satisfaction, individual and organizational impact. Application of this model is strengthened by the relationships between and among its dimensions and can be applied not only to validate the model's characteristics, but also to establish the magnitude of interdependencies and relationships between and among the components. The model was designed to reflect the interdependent or process nature of information system success (DeLone and Maclean, 1992). Challenges to the initial model prompted modifications to include a service quality measurement and a combination of the impact measures to express net benefits of the system which identifies impact of the system beyond the user and include the impact on any connected entities such as the organization and the society (DeLone and MacLean, 2003).

The D&M IS Success Model has been adopted, applied and used with measurement indicators of system quality (ease of use, functionality, reliability, flexibility, data quality, integration, portability, importance), information quality (accuracy, timeliness, completeness, relevance, consistency), use (frequency of use, time of use, usage patterns, number of access, dependency), user satisfaction, organizational impact and individual impact (DeLone and MacLean, 2003).

The strength of this model lies in the relational interconnectedness of its components. In practice, the model allows researchers and evaluators to apply both quantitative and qualitative modes of inquiry to fulfil data requirements (Yu, 2010). A mixed methodology approach makes it adaptable extensively in evaluating information system effectiveness and holds a promise in assessing the effectiveness of web based applications. The weaknesses of this model are lack of capacity to assess contextual factors of an infostructure and an inadequate coverage of factors associated with system failure (Van Der Meijden *et al*, 2003). These weaknesses have led to efforts to combine the model with other evaluation frameworks. For example, the HOT-fit evaluation framework incorporated the D&M IS Success Model and was developed to address some of the weaknesses of the model (Yusof *et al*, 2008). Development of the Hot-fit evaluation framework consisted of six iterative phases, which include problem identification, development of an initial evaluation framework, selection of research strategy and methods, system evaluation, framework validation, and refinement of the evaluation framework (Yusof *et al*, 2008). Given its inadequate attention to contextual factors, adaptation of the HOT-Fit model to primary health care will have to address primary health care attributes such as accessibility, care coordination and partnership with patients, as shown in Figure 5 below.

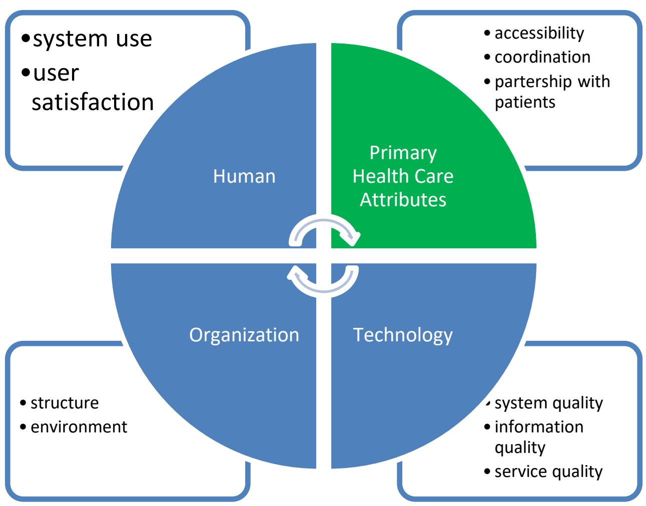

Figure 5. HOT Fit Model with Primary Health Care Attributes

2.3.2 Summary of major frameworks and models

In this section, I present a summary of major frameworks and models for evaluating EMR examined in this thesis, their development year, main features, strengths and weaknesses.

Framework/Model	Year Dev'd	Features	Strengths	Weaknesses
DeLone and Maclean Information Systems Success Model	1992, Updated 2002	Technical and semantic qualities	Interdependency among components	Lacks capacity to assess contextual factors
CHEATS Framework	2002	Clinical, human, organizational, technological and social aspects	Supports use of qualitative and quantitative modes of inquiry	Too broad in scope
Health Metrics Network Framework	2006	Support for national health information systems productivity	Emphasis on role of stakeholders	Difficult to guarantee accuracy of information for country by country comparison
Canada Health Infoway Benefits Evaluation Framework	2007	Measures of system quality, access and productivity	A variety of evaluation measures, Retains relational significance of components	Missing socio-organizational and contextual factors
HOT Fit Model	2008	Identifies human, organizational and	Relational interconnectedness of components. Adaptable to mixed research methods	Does not adequately address contextual factors and needs to be modified to address shortcomings
PRISM Framework	2009	Technical, organizational, and behavioral performance factors	Support for performance monitoring within organizations	Lacks capacity to assess external factors impacting on performance

Framework/Model	Year Dev'd	Features	Strengths	Weaknesses
eHealth Value Framework	2014	Measures of investment, adoption and value	Contextual factors at micro, meso and macro levels, Time lag component	Value measured in terms of adoption rather than use. Conflates adoption and use.

Table 3. Summary of major frameworks and models

2.4 Maturity models

Maturity models were first developed for information technology and system engineering organizations based on the theory of stages of growth (Nolan, 1973) which stated that the evolution of information systems in organizations undergo a series of incremental stages, beginning with an initiation stage characterized by user awareness and emphasis on functional applications. The initiation stage is followed by stages of contagion, control, integration, data administration and maturity (Nolan, 1973). At the most basic level, a maturity model can be described as set of characteristics, features, indicators, attributes, patterns or configurations that represent evolution, progression and attainment of an ideal state in a particular domain. Maturity models provide organizations with an ability to benchmark and assess progression over time and in comparison, to similar organizations.

The structure of maturity models generally involves stages or levels along an evolutionary scale that defines measurable transitions from one level to another (Caralli, Knight & Montgomery, 2012). Measurable transition stages enable an organization to determine its current stage, identify measurable indicators that it must attain to determine and transition into a future, mature state. Users may focus on improving within a particular level or a group of levels. Progression from lower levels through mid-levels to higher levels generally represent a prescribed improvement through various levels in order to achieve intended results. This represents the roadmap to maturity. The roadmap is aided by an appraisal or scoring method to facilitate assessment using a common and consistent standard for measurement.

In addition to levels representing transitional states, maturity models are generally composed of attributes which represent the core content of the model grouped together at each level. Attributes may be presented as features, characteristics, practices, indicators, standards, pre-defined qualities or processes (Caralli et al., 2012).

Like many organizations adopting and using technologies, primary health care organizations and service providers are realizing that challenges related to proper management of care delivery processes are related to limitations of health information and technology infrastructure and management. The evolution of an organization's health care delivery processes are often related to a maturity level. Nolan's theory on stages of growth can provide a useful framework for evaluation in general and represents an idealized conceptualization of the evaluation process. Due to specific attributes and characteristics of primary health care, Nolan's model and its offshoots have a number of weaknesses. First, they fail to adequately account for the fact that primary health care is characterized by the ongoing presence of a range of technologies and multiple processes and procedures at different stages of development, testing and application. Second, they fail to account for the existence of related technologies such as hospital-based information systems that are linked to primary health care practices which may be at a different level of maturity compared to the primary health care information system. In primary care, an infinite volume of information resources necessitates that the solution to evaluation problems are not confined to a range of limited alternatives. Despite these limitations, a stages model is useful because it divides the evaluation process into manageable chunks, and it can be modified to address related current and future evaluation efforts.

Maturity models are developed on the idea that people, organizations, functional areas, processes, evolve through a process of development or growth towards a more advanced maturity level encompassing several stages. For example, the Capability Maturity Model (CMM) aimed at improving software development processes, has been used as reference model for further development of specialized maturity models in health care (de Carvalho et al., 2015; Galliers & Sutherland, 1991; Khandelwal & Ferguson, 1999). Several models have been developed over the years with additions and modifications to the original Nolan Model. For example, Galliers and Sutherland (1991) developed a model consisting of six stages matching modern network organizations along with tools for data collection to assess maturity and Khandelwan and Ferguson (1999) developed a model consisting of nine levels with a combination of theoretical basis for critical success factors.

Model	Main Focus and Characteristics	Reference Model(s)	Number of Levels
Canadian EMR Adoption and Maturity Model	Electronic Medical Record, Adoption	N/A	6
HIMSS Electronic Medical Record Adoption Model (EMRAM)	Electronic Medical Records	N/A	8
HIMSS Continuity of Care Maturity Model	General, Continuity of Care	EMRAM	8
HIMSS Usability Maturity Model	Usability	Schaffer, Nielsen, Earthy Usability Models	5
IDC Healthcare IT Maturity Model	General, Healthcare IT	N/A	5
IDC Mobility Maturity Model	Mobile Health	CMM	5
Healthcare Analytics Adoption Model	Data analysis and warehousing	EMRAM	9
PACS Maturity Model	Picture Archiving and Communication Systems	CMMI	5

Model	Main Focus and Characteristics	Reference Model(s)	Number of Levels
NHS Infrastructure Maturity Model	General, Healthcare IT Infrastructure	CMM	5
Hospital Cooperation Maturity Model	Hospital Networks, Organizational Processes	CMM	4
NEHTA Interoperability Framework	Interoperability	IMM/CMMI	5
Telemedicine Service Maturity Model	Telemedicine	CMM	5

Table 4. Examples of maturity models in health care

Maturity models in health care organizations have focused mainly on hospital-based information systems and technologies (Sharma, 2008). Examples of maturity models developed for electronic medical records and electronic patient records include the HIMSS EMRAM and the Continuing Care Maturity Model. National organizations such as the eHealth Transition Authority of Australia and the NHS in the United Kingdom have developed the Interoperability Maturity Model (Government of Australia, 2007) and the NHS Infrastructure Maturity Model (NHS, 2011) respectively. These models are used by the national organizations to conduct self-assessment of their technological infrastructure.

The main features of a selection of maturity models currently existing in health care follows. The maturity models presented below are either highly specialized with specific areas of focus, or very general and comprehensive, encompassing various areas of health care information technology. The highly specialized models are often used in hospital settings or for specific components within a hospital environment, while the more comprehensive ones were designed for entire health systems, some at national levels such as the NHS Healthcare Information Technology Infrastructure Model. None of the models have been developed to address the specific needs of primary health care and most of the models do not disclose the design or research processes for development and validation. The number of maturity levels also varies. As a result of this literature review, none of the identified models has sufficient features to cover the area of primary care adequately. For this reason, a new model is necessary to fill this gap which will include the main influencing factors and attributes of primary health care.

2.4.1 Canadian EMR adoption and maturity model

The Canadian EMR Adoption and Maturity Model is a product of collaboration and combination of features of four jurisdictional EMR adoption models from the Canadian provinces of Alberta, British Columbia, Manitoba and Ontario. Based on commonalities such as breadth of usage (e.g. number of units within a facility, number of providers, patients or other key descriptors of usage and adoption) and functionality (e.g. common clinical care processes, practice administration), the model is intended to portray the advancement in adoption and maturity as users of electronic medical records progress through levels (COACH, 2013). The model identifies and categorizes EMR level progression into serial (adoption levels 0 through 3) and iterative (adoption levels 4 and 5). Information gathered and reported through surveys will inform the specific level of adoption and maturity, with expectation that full capability and corresponding functionality of the level has been demonstrated. The model incorporates seven broad functional categories namely, practice management, information management, patient results management, diagnosis support, treatment planning support, patient engagement and communication, and evaluation and monitoring. A summary of functionalities at each level is clearly articulated in the model. This model conflates EMR adoption and EMR use.

2.4.2 HIMSS Maturity Models: EMRAM, CCMM, UMM

The Electronic Medical Record Adoption Model (EMRAM) was developed by Healthcare Information and Management Systems Society (HIMSS) Analytics. EMRAM is an eight-stage scoring approach and maturity model reflecting the electronic medical record capabilities in hospitals and is perhaps one of the most commonly applied and cited EMR maturity models. Its stages range from a completely paper-based patient records environment, represented as Stage 0, to a highly advanced 'paperless', digital patient record environment, signified as Stage 7. More than 10,000 hospitals around the world have adopted the model including about 5460 in the United States and 641 in Canada. Hospitals in Australia, the Middle and Far- East have adopted and applied the model (HIMSS Analytics, 2009) (HIMSS, 2014). According to HIMSS Analytics, the structure of this model ensures that movement between and up levels is reached only when all applications at the level are operational. HIMSS CCMM was developed to support the optimization of results in health systems and patient satisfaction, it extends beyond the EMRAM by addressing the convergence of interoperability, information exchange, care coordination and patient engagement both at an individual and population levels. The model has the ability to assess implementation and use of information and communications technologies by health services providers to optimize clinical and financial processes. In 2016 HIMSS developed the Outpatient EMRAM in addition to the Ambulatory EMRAM developed earlier (Healthcare Information and Management Systems Society, n.d.).

The Continuity of Care Maturity Model (CCMM) was developed to help optimize and measure the results of care coordination by organizations responsible for defined communities. Based on the EMRAM model, CCMM measures the degree to which such organizations at local, regional or national levels provide an environment and services supporting a care community with health information exchange, patient care coordination, patient engagement and advanced analytics. It consists of eight maturation levels and addresses the convergence of interoperability and assessment of implementation and use of health information technologies by health services providers in order to measure and optimize clinical and financial outcomes (Healthcare Information Management Systems Society, n.d.). Similar to EMRAM, the CCMM requires unique set of capabilities to be met prior to advancing with an overall goal of reaching a truly interconnected health care delivery model.

In 2011, HIMSS EHR Usability task force established the HIMSS Usability Maturity Model and described the key objectives of utilizing the model within organizations. Different phases of the model represent the level of maturity achieved when user-centered design becomes fully integrated within a healthcare organization. The model consists of five stages and in each of the five stages, attention is paid to attributes related to users, organizational management, resources, processes, infrastructure and education (Staggers & Rodney, 2012). The model can serve as a guide for organizations to assess current usability maturity and ways of transitioning to higher levels in an effort to improve user experience, lead institutional effort to improve organizational awareness of usability and to allocate increased resources or infrastructure to usability. In order to test its validity and effectiveness, developers of the model survey organizations about their usability practices across a range of factors and compare findings with the model. Model testing could also involve the use of expert panels to refine and validate the model.

2.4.3 OntarioMD EMR Maturity Model

The EMR Maturity Model developed by Ontario MD (2012) was designed to measure use and value of an EMR by physicians. It is used by physicians in South West Ontario and complements the EMR progress assessment tool developed to help physicians optimize their EMR use and make practice improvements. The model represents the existing and potential capabilities of an EMR in an evolving e-health landscape and represents six levels of EMR maturity across three functional areas within a practice, using 10 key measures to evaluate a physician's level of EMR use (Jones et al., 2017; OntarioMD, n.d.-b, 2012). The ten key measures are 1) appointment scheduling with key objectives of improving access through efficient scheduling and coordination of care and improving clinician's time management and service provision; 2) practice billing with key benefits of maximizing incentive fees and increasing control of billing and submission internally; 3) communication and messaging with key objectives of increasing ease and speed of communication among clinicians, and patients; and enhancing the patient experience with more timely and effective communication; 4) encounter documentation with key objectives of improving compliance with standard of care and ability to share patient information more efficiently, as well as improving access to comprehensive patients' medical history and better clinical decisions; 5) data quality and nomenclature consistency which are aimed at improving consistency of coding within the clinical workflow and support quality reporting, maximizing clinical decision support, searching capabilities, and improving sharing of information in a reliable manner without losing intended meaning; 6) document management with key objectives of improving quality of documentation and administrative efficiencies (searches, scanning, coding clinical documentation, etc.); 7) results management with key objectives of increasing speed of access to patient information, providing key information for analysis of treatment trends and patterns and improving ability to track patient's compliance over time and monitor progress of treatment; 8) referral and consultation tracking for both primary care and specialists, aimed at increasing speed of access and delivery of information to patient, saving time and reducing wait time; 9)prevention and screening with key objectives of being more proactive about activating patients overdue for routine screening or gaps in care, increasing patients' compliance with preventive care recommendations and optimizing preventive care bonuses; and 10)complex care and chronic disease management with key objectives of improving adherence to optimal standard of care, proactive monitoring, improving patient compliance and greater consistency on quality of care.

Level	Criteria	Capabilities
5	**INTEGRATE**	Use of portals, hubs, attachment to provincial e-health platforms sharing data from the EMR.

Level	Criteria	Capabilities
4	**POPULATION DATA USE**	Dashboarding of whole populations, acting upon the whole, performing population analysis at the practice level.
3	**LOOK AHEAD / PREDICT**	Reminders and alerts are used at the point of care. Searches are done regularly and scheduled for review.
2	**EARLY DATA USE**	Acting upon the output of episodic searches, quick entry tools, forms, calculators, etc.
1	**ENTER DATA**	Documentation occurs electronically. Progress notes, forms, and other documents are entered into the EMR.
0	**PAPER**	Processes are primarily paper based.

Table 5. OntarioMD EMR Maturity Model

The model provides a solid basis for organization and assessment of key areas of primary care physician EMR use yet fails to directly address integration at every stage. It places integration in the fifth level, only as the final component of a fully mature system, which was the way that electronic records were originally deployed and considered in Ontario. This was understandable since a certain critical mass of EMR users is needed before connectivity and interactive use could take hold. The key objectives and benefits do not appear to be operationalized to be measurable using the maturity model. For example, the stated objectives related to tracking and increasing patient compliance or enhancing patient communication have not been fully operationalized to be reflective of not only the levels but also the criteria and capabilities of the maturity model. For the model to serve as a useful and actionable tool for primary care practices, it would be critical to have better alignment of key capabilities with the levels of the maturity model.

2.4.4 Summary of maturity models

A summary of major maturity models examined in this thesis, year of development, main features, strengths and weaknesses are presented below.

Model	Year Dev'd	Features	Strengths	Weaknesses
EMRAM	2005	Clinical, nursing decision support, controlled medical vocabulary	Accessible benchmark, commonly applied across North America and Europe	Could be implemented out of order or by ward rather than hospital wide, incentivizes cost savings to the payer without adequately addressing integration with patients
Ambulatory EMRAM	2012	Health Information Exchange capabilities	Emphasis on ambulatory care, based on proven EMRAM methodology	Difficult to guarantee accuracy of information from diverse ambulatory and community-based sources

Model	Year Dev'd	Features	Strengths	Weaknesses
Canadian EMR Adoption and Maturity Model	2013	Serial and iterative qualities	Major jurisdictional buy-in, supports clinical processes and workflow	Conflates EMR adoption with EMR use. Does not address integration with patient resources
Continuity of Care Model	2014	Focus on regional and national health authorities, integrated networks, communities of care	Emphasis on communication exchange, interoperability and multi-organizational interconnectedness	Lack of common language, terminology across various health authorities and communities of care, variation in mandates of participating organizations
Outpatient EMRAM	2016	Patient health record, advanced decision support, structured messaging	Broad scope that includes primary care, specialty practices, urgent care and long-term care facilities	Missing integration features, stages may be implemented out of order, primary care workflows not included
OntarioMD EMR Maturity Model	2012, updated 2016	Captures appointment scheduling, practice billing, communication and messaging, encounter documentation, data quality and nomenclature consistency, document management, results management, referral and consultation tracking for primary care and specialists,	First (possibly the only) maturity model for primary care EMR in Canada. Most widely applied among physicians in primary care Ontario than any other model. Methodology could serve as basis for developing future maturity models, Incorporates major EMR maturity indicators. Excellent benchmarking	Missing integration features. Assumes EMR use only by the practitioner. Susceptible to conflation of communication with integration as it does not address integration with patient resources, community resources, other primary care providers or integration tools. Does not account for EMR transition or data migration.

Model	Year Dev'd	Features	Strengths	Weaknesses
		prevention and screening, complex care and chronic disease management	capability potential.	

Table 6. Summary of maturity models

2.5 Chapter summary

The literature review section presented the state of knowledge from EMR studies and primary health care information including factors affecting the use of information technologies in primary health care. The EMR studies covered the historical evolution of Canada's health infostructure, the multiple research traditions in EMR research, as well as the attendant tensions and paradoxes that characterize fields with multiple research traditions. Despite recognition of the importance of integration of the EMR, the literature review revealed that many studies focus on investigating impact and business value, leaving a large research gap on success or progress of EMR integration especially at regional levels.

Discussion of integration touched on interoperability and eHealth integration initiatives in Canada generally, and Ontario, specifically. Progress made in South West Ontario is reported in the literature. However, challenges and hazards of regional integration of EMRs is not adequately represented in the literature. The chapter addressed evaluation studies, evaluation frameworks and maturity models, providing several examples and comparisons. With the background information gathered from the review of literature, the next chapter transitions to the research design, highlighting the importance of the research paradigm, presenting the research methods, sampling and recruitment, criteria for quality, ethical consideration, data preparation and analysis.

Chapter 3

3 Methodology and methods

In this chapter, I present the research design employed in this study. Starting with the research paradigm and situating my role as a researcher, the chapter provides details of the study methodology and methods, sampling and recruitment, data collection, data analysis, and the research quality and ethical considerations.

3.1 Research paradigm

Given the It is important to explicitly demonstrate both the research paradigm of this study and my standpoint as a researcher. A paradigm is described as research philosophy guiding how the research is to be thought about and conducted (Gliner & Morgan, 2000; Guba & Lincoln, 1988, 1994) . It represents the researcher's broad framework which includes perceptions, personal beliefs and the understanding of various theories and practices used to conduct the research that guide action in connection with disciplined inquiry. The paradigm impacts on decisions related to whether the selected research will be qualitative, quantitative or mixed methods. The paradigm also affects the selection of research methodologies. As Guba and Lincoln (1988) described it, "paradigms do imply methodologies, and methodologies are simply meaningless congeries of mindless choices and procedures unless they are rooted in the paradigms" (p.114). Guba and Lincoln (1994) further maintain that "paradigm issues are crucial; no inquirer ought to go about the business of inquiry without being clear about just what paradigms informs and guides his or her approach" (p.116).

I argue that research on the EMR tends to focus on describing applications or providing solutions to practical, technical problems without first analyzing how the adoption of various epistemological standpoints affect the definitions of the problems to be solved and the approaches to solving them. For instance, studies in EMR literature generally adhere to positivist and post-positivist paradigms, yet, several studies in other fields adhere to multiple paradigms. As noted by Schnelker, (2006), "this current moment [of multiple paradigms] increases the need to ensure that graduate students understand the paradigmatic distinctions, and the significance of these distinctions, for reading and conducting research" (p.43). This is because personal view of reality and how we know what we know, often tacit or taken for granted, are influenced by experiences, social location, disciplinary location, etc." (D. Rudman, personal communication, September 14, 2015). Common research designs in EMR research have paradigmatic underpinnings not always explicitly stated by researchers in the conduct of research. Paradigms are a "set of interrelated assumptions which provides a philosophical and conceptual framework for the organized study of the world" (Filstead, 1979, p.34). More recently, paradigms have been defined by Bunniss & Kelly (2010) as "sets of beliefs and practices, shared by communities of researchers, which regulate inquiry within disciplines" (p.360).

The methodology or school of inquiry refers to a “bundle of skills, assumptions and practices the researcher employs as he or she moves from paradigm to the empirical world” (Denzin & Lincoln, 2000, p.22). Holloway & Todres, (2003) encourage researchers to be thoughtful, context sensitive and flexible with various approaches and to research.

3.1.1 Role of the researcher

The role of the researcher in quantitative studies is often viewed differently from qualitative studies. The researcher in quantitative studies, in theory, plays little or no role in determining the research outcome. Based on positivist tradition of capturing objective reality (Fink,2000), participants’ actions and responses, and by extension, the results of the research do not depend on the researcher (Fink, 2000). Quantitative research presupposes that the truth that emerges from the research process or the knowledge derived thereof is obtained without bias due to non-interference of the researcher in the process. The lesser the biases of a researcher in the research process, the more objective the results. The experiences and preferences of the researcher may however manifest in the decisions such as the analytical technique, or question choices made during the research process. It is important to acknowledge that such decisions may influence the research outcome. According to Fink (2000), the role of the researcher in qualitative research changes significantly from that of an architect or discoverer of objective reality to one whose experiences are brought to bear in the research process. Denzin & Lincoln (2011) describe qualitative research as a set of activities in which the researcher is situated in the world of research. The researcher is viewed as the primary data collection instrument such that actions taken by the researcher are often reflective of the overall objective of the research.

Overall, the starting point of the research approach involving constructivist grounded theory is acknowledging that reality is multiple, processual, and constructed (Charmaz, 2014b). The researcher's perspectives, privileges, and interactions need to be taken into consideration in the research process. Furthermore, recognizing that reality exists within contexts and includes the contributions of researchers and participants is an essential component. Researcher's reflexivity is important. For this reason, I provide my role as a researcher in this project, situating myself in EMR research.

My background and prior experiences provided the context that I went into this research with certain knowledge, presuppositions and predispositions. My health informatics academic background corroborated my interest in pursuing research on electronic records. I majored in Health Informatics at both undergraduate and master's levels which helped me gain a significant insight into the use of information and communications technologies in the management and administration of health care systems. I had the opportunity to develop and carry out health informatics projects such as e-health and e-learning projects for prostate cancer patients, health care database design and implementation, meta-evaluation of health care programs, among others.

These early experiences exposed me both to the benefits and challenges of electronic health information systems use and impact. These facts coupled with my experience as a health information analyst with particular interest in digital health, primary care and population health, spurred my curiosity regarding the use and impact of electronic medical records in primary care, as well as the broader integration of electronic health information resources. Given the proliferation of electronic medical record systems it was natural for me to wonder how challenges accompanying implementation could be mitigated and the promise of a fully integrated health information system could be attained. In the end I decided that I might be able to help provide a better understanding of the use and impact of EMR by examining key issues relating to integration of electronic health information in a regional setting. It is important to note that the utility of being present in South West Ontario while attending Western University for my PhD studies, coupled with access to local physicians through local medical schools, the cSWO initiative and the local regional health system, all played a role in helping me develop and advance this research. This thesis is both qualitative and quantitative and I have adhered to the principles of both research approaches. I consider myself as the primary instrument of data collection, analysis and interpretation, particularly in the qualitative aspects of the research.

3.1.2 Constructivist epistemology

By definition, ontology refers to the nature of being or the nature of reality (Finlay & Ballinger, 2006). According to Tennis (2008), epistemology refers to ‘how we know’. To explain the concept of constructivist epistemology and its relevance to this thesis, I will further explain the constituent terms, epistemology and constructivism, and then provide a brief independent description of each.

Epistemology “is concerned with the theory of knowledge and the role of science” (Finlay & Ballinger, 2006, p.18). It is a core branch of philosophy, that relates to its methods, scope, and validity of knowledge. Researchers generally use key questions to substantiate the basis of epistemology: What is knowledge? How can we obtain knowledge? How can we come to know reality? What is the relationship between the knower and the world being known? Who can be a knower? What is important to know? Can knowledge be independent of time and context? Can universal laws be formed? These questions deal with the nature of knowledge.

In this thesis, knowledge represents the interpretive deductions drawn from participants’ responses. It is reflective of the experiences of EMR use and impact expressed by primary health care physicians within the bounds of my interpretive contemplation. Some of the questions on the basis of epistemology deal with justifying claims of knowledge. For example, “what is important to know” and “what is the relationship between the knower and the phenomenon under investigation" concern the explication of the basis of knowledge. In recognition of this, I put value on the multiplicity of participants' responses to the research questions and issues in determining the common emerging patterns in their experiences of the use and impact of the EMR. In other words, knowledge within the context of this thesis is created by closely examining the data, then comparing and contrasting participants' responses and facts as they relate to what is being investigated.

Charmaz (2014) points out, in the context of research, that both participants and researchers work co-constructively to produce certain forms of understanding. Charmaz (2014) further argues that the "constructivist approach shreds notions of a neutral observer and value-free" investigator (p. 13). Constructivism is a learning paradigm which presupposes that knowing is an active, constructive process. This is a research position that views knowledge as "not passively received wither through the senses of by way of communication, but is actively built up by a perceiving, cognitive subject" (Finlay & Ballinger, 2006, p.258).

In completing this project, I regarded *what is known* about EMR use and impact as transient, dynamic and adaptive as each new piece of data gets added to the analytic mix. I considered knowledge to be in a perpetual state of construction. In keeping with the constructivist approach, I acknowledge that knowledge produced in this thesis started in the minds of research participants as they constructed and reconstructed their EMR experiences with words, gestures and actions, as well as in my own mind as I tried to make sense and obtain meanings both from what they reported and what they did not report. Grounded theorists such as Corbin & Strauss (2008) subscribe to this idea that knowledge is constructed by researchers and participants as they attempt to make sense of their experience, stating that "concepts and theories are constructed by researchers out of stories that are constructed by participants" (p. 10). Based on these, it is important that I not only should be reflexive and aware of my privileges as a researcher, but also be open about my active role in the construction of the findings and how my experiences may have influenced the knowledge or facts that emerged from this thesis. The need for self-awareness and critical reflection on self and context of research undergird the process of knowing in this thesis based on constructivist epistemology. Locating myself in EMR research reflects my role in the research as I assume that the findings reported are not only the product of the interactions between research participants and me, but also the outcome of our interactions and the context of the research. These understandings played a role in the overall design of the research.

3.2 Research methodology

I used mixed methods with grounded theory as the methodological approach for my thesis. Developers of grounded theory encouraged the use of grounded theory with both quantitative and qualitative data (Charmaz & Belgrave, 2012; Glaser & Strauss, 1967; Holton & Walsh, 2020) and addressed the merits and demerits of using grounded theory in pluralistic research designs such a multimethod designs (qualitative-qualitative) and mixed-methods designs (quantitative-qualitative) (Charmaz, 2014a). I decided this approach most appropriate for my research given the use of observership and shadowing, interviews and survey. In a narrow sense, mixed methods are a design for collecting, analyzing and mixing both qualitative and quantitative data in order to understand a research problem(Creswell & Plano-Clark, 2007). In a broader sense, mixed methods "combines the elements of qualitative and quantitative research approaches (e.g. use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purpose of breadth and depth of understanding and corroboration" (Johnson et al., 2007, p.123). Mixed methods design uses a combination that best helps to frame, describe, explicate and address the research questions, with emphasis on pragmatism from a paradigmatic standpoint. Mixed methods research has been described as the pragmatism of the "middle" (Hesse-Biber & Johnson, 2013; Johnson et al., 2007)as the researcher grapples with the question of what comes first in a research process; the research question or the research paradigm? Giddings & Grant (2007)) question whether pragmatism side-steps important ontological or epistemological issues and whether mixed methods research design is a trojan horse for positivism and post-positivism. Despite the contention among researchers about the mixed methods research paradigm, it is “critical not to lose sight of the centering of the research question” (Hesse-Biber & Johnson, 2013, p.103). as what becomes most important then is the framing of the research questions.

Grounded theory was developed as a qualitative research method by Glaser & Strauss (1967) in their book *The Discovery of Grounded Theory: Strategies for qualitative research*. The work was deemed revolutionary at the time because it challenged long held views against the quality of qualitative research and endless critiques of the rigor of qualitative research compared to quantitative research. Grounded theory provided systematic and explicit analytic procedures and research strategies that did not exist before in qualitative research (Charmaz, 2000). It has been described as an inductive methodology that permits the researcher to develop a theoretical explanation of the general features of a phenomenon under study while ‘grounding’ the account in empirical observations or data at the same time (Glaser & Strauss, 1967). As a research methodology, grounded theory is a “general methodology for developing theory that is grounded in data systematically gathered and analyzed” (Strauss & Corbin, p. 273). A feature of grounded theory is that a theory develops and emerges out of data and not prior to data collection, that is, the emergent theory is grounded in the research data collection and analysis. In using such an approach, a grounded theory is discovered, developed and provisionally substantiated through data collection and analysis of data pertaining to a particular phenomenon.

According to Charmaz (2011), the term grounded theory refers to the research methodology and its product; the product is a theory that is grounded in data. Defining what is meant by theory, Kerlinger (1973) described it as "a set of interrelated constructs (concepts), definitions, and propositions that present a systematic view of phenomena by specifying relations among variables, with the purpose of explaining and predicting the phenomena" (p.9). Glaser and Strauss agreed with this definition and further explained that a good theory should not only explain and predict but also be useful to be applied and developed. In their view, the roles of the theory are to "enable prediction and explanation of behavior, be useful in theoretical advance; be useful in practical applications, predictions, and explanations…to guide and provide style for research on particular areas" (Glaser & Strauss, 1967, p.3).

Grounded theory is applicable in areas where little research has been done. There are few research activities or outputs in the area of regional integration of electronic medical records or in examining the perspective of primary care physicians on the use and impact of electronic medical record. Grounded theory was selected for this study because it can help with development of theory that could serve as precursor for further investigation into regional integration of EMR. Moreover, among several methodological traditions under the umbrella of qualitative research, grounded theory represents the best investigative technique for examining most of the research questions in this thesis, and for developing theoretical interpretations of the overall nature of the issues that emerge from the study.

The main rationale behind the combined use of both qualitative and quantitative approaches in this thesis stemmed from my need and desire to better understand the problems of the use and impact of EMR by primary care physicians within a regionally integrated health care system. Given the complexities of the issues being examined, I believe neither qualitative nor quantitative method, applied alone, would have given me the flexibility to examine the issues rigorously. Moreover, the application of mixed methods research design also provided me with more investigative tools to examine the issues of interest and concern. As noted by Flick (2002) (cited in Denzin & Lincoln, 2008) the combination of multiple methodological practices, techniques, and viewpoints in a study “adds rigor, breadth, complexity, richness and depth to any inquiry” (p. 7). Essentially, the application of mixed, qualitative and quantitative, research design in this thesis enabled an in-depth analysis and understanding of the issues related to the use and impact of EMR by the research participants As shown in the table below, I applied mixed methods techniques in both data collection and analysis phases.

Research Question	Data collection	Data analysis	Objective
1. How do physicians in primary care and family medicine use regionally integrated EMR in Southwest Ontario?	Observership and Shadowing Semi-structured interviews Questionnaire	Grounded Theory approach Qualitative Data Analysis Software: Nvivo Statistical Analyses (Descriptive, univariate, test of differences, ordinal regression)	Provide a description of typical use of EMR in primary care practices
2. What are the perceptions of primary care and family medicine physicians in Southwest Ontario about regional integration of Electronic Medical Record (EMR)?	Semi-structured interviews	Grounded Theory approach Qualitative Data Analysis Software: Nvivo	Describe physicians' experiences of EMR and their perception of regional integration of EMR
3. What are the principal factors that influence the use of regionally integrated EMR in Southwest Ontario?	Questionnaire	Statistical Analysis (Descriptive, univariate, test of differences, ordinal regression) Quantitative Data Analysis Tool: SPSS	Explain and describe the main influencing factors on the use and impact of regionally integrated EMR
4. How do physicians in primary care and family medicine experience the impact of integrated EMR in Southwest Ontario?	Semi-structured interviews Questionnaire	Grounded Theory approach Qualitative and Quantitative Data Analysis Tools: Nvivo & SPSS	Describe physicians' experiences of the impact of EMR and their perception of impact of regional integration of EMR
5. What challenges do physicians face in using regionally integrated EMR?	Observership and Shadowing Semi-structured interviews	Grounded Theory approach Qualitative Data Analysis Software: Nvivo	Explain and describe the main issues, problems and challenges physicians face in the use regionally integrated EMR

Table 7. Summary of research questions and methods

Table 7 summarizes the research questions alignment with components of mixed methods research applied in this thesis. The decision and choice of research method used for investigating each of the research questions depended not only on investigative convenience, but also a much deeper consideration for the need to gain deeper understanding and richer insights into the use and impact of EMR in the region.

3.3 Research design

Research design refers to the description of the plan and procedures for research, taking "decisions from broad assumptions to detailed methods of data collection and analysis" (Creswell, 2009, p.3). Research design involves selected plans of the kind of data needed to explore the research questions and to specify approaches to gather or generate data needed to answer the research questions (Gibson & Brown, 2009). The plans and procedures applied in this thesis are depicted in Figure 6 below.

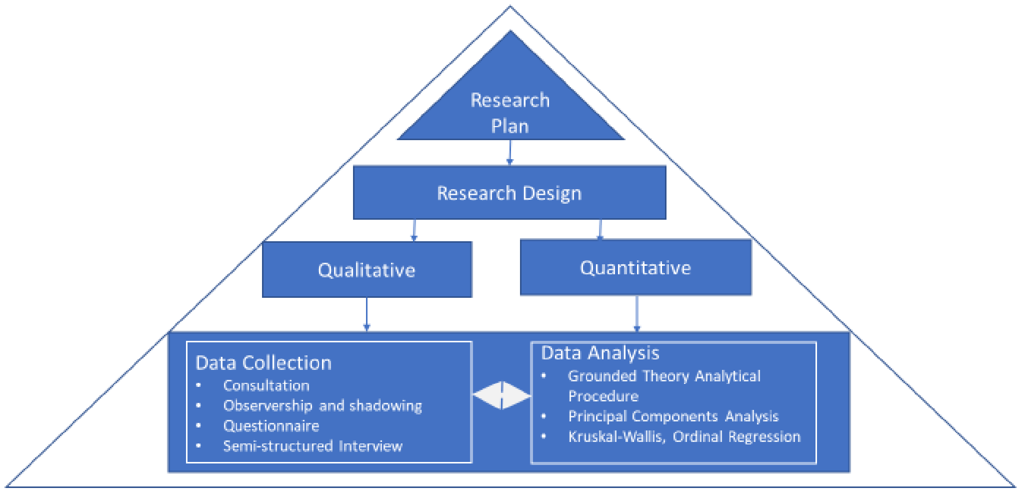

Figure 6. Research Design

3.3.1 Study locations

At the time the research was conceptualized and conducted, there were four Local Health Integration Networks (LHINs) in South West Ontario, all four constituted the regional hub for eHealth Ontario's cSWO program, as show in the table and map below. As shown in Table 8 below, South West Ontario region was subdivided into four LHINS which acted as health authorities and administrative units responsible for regional administration of public health care services in the province of Ontario (eHealth Ontario, 2014; Haq et al., 2015)

Study Location	
<u>LHIN 1 - Erie St. Claire</u>	<u>LHIN 3 - Hamilton Niagara Haldimand Brant</u>
Lambton	Brant
Essex	Burlington
Chatham-Kent	Haldimand-Norfolk
<u>LHIN2 - South West</u>	Hamilton
Grey	Niagara
Bruce	<u>LHIN 4 - Waterloo-Wellington</u>
Huron	Waterloo Region
Perth	Wellington County
Middlesex	City of Guelph
Oxford	Southern part of Grey County
Elgin	
Part of Norfolk	

Table 8. South West Ontario LHINs and Counties

3.3.2 Data collection

The target population for recruitment was practicing physicians working in primary health care in Southwest Ontario (approximately 3000). Research participants for both quantitative and qualitative components were drawn from this population and identified from names and contact information available publicly in the 2016 version of the Canadian Medical Directory. To collect data from this population, I was mainly interested in the use of regionally integrated electronic medical record as well as everything that facilitates or hinders its use in the region. EMR use includes not only actual use but also intention to use. I was interested in data about the use of EMR to coordinate care activities between and among primary health care practitioners and patients to facilitate appropriate delivery of primary health care services. Also, of interest was to the extent to which health information is linked and exchanged to address primary health care challenges, coordinate care processes and workflows, and deliver primary health care and related services. I wanted to know their views about the performance of the electronic medical record in terms of ease of use, content, features, response time, security, and other measures of the intrinsic features of the electronic medical record. Given these areas of interest for this investigation, data collection involved ‘lay of the land’ consultation, observership and shadowing, self-administered questionnaire and semi-structured interviews.

3.3.3 Observership and shadowing

Upon advice of my thesis supervisor, I embarked upon the process of observership and shadowing of family physicians. This provided me with the opportunity to explore, understand, apply and synthesize prior learning on use of EMR in real world clinical settings. Observership is typically a clinical or interprofessional health education learning opportunity within Canada during which a student observes a licensed and registered physician interacting with patients in a clinical setting or an interprofessional health educator affiliated with an accredited hospital.

While observing physicians and residents, nurses and allied primary health care practitioners, I became familiar with care practices and gained firsthand insight into the use of electronic medical record in primary health care. Shadowing served as an important learning experience and opportunity to network in the community as the research process progressed. Furthermore, observership and shadowing helped me to identify the types of information systems, particularly EMR offerings currently available at the family medical clinics and centers, as well as the organizations responsible for managing data standards and quality, the challenges being encountered by health professionals using the systems and the observed experiences of the primary health care physicians and patients.

The period of my observership and shadowing lasted from June, 20th, 2016 to August, 30th , 2016. Prior to that, 'lay of the land' consultations were held with three primary care physicians in the region to help me gain familiarity research environment and typical or representative research participants. Observership was sponsored by physicians at the primary care practices in London Ontario and conformed with the guidelines set by London Health Sciences Centre. The observation did not include any form of direct patient care, documenting on patient's health records, either electronic or hard copy format, having independent access to health records, either electronic or hard copy format or any direct interaction with patients. The sponsors always obtained verbal consent of the patients for my presence prior to observation. In addition to signing observer confidentiality agreement, I completed a self-screening health evaluation as well as infection prevention and control core competency training prior to the start of the observership period.

The three primary care practices where physician observation and shadowing occurred consisted of a family medical center and family health teams. Four primary care physicians were observed during nine sessions, each shadowing session comprised of a 4-hour block, equivalent to a total of 36 hours. One of the practices included academic medical teams affiliated with the department of medicine at a south western Ontario medical school. The practices typically had family physicians and residents. Allied health professionals or interdisciplinary health professionals fully participated in and use health information systems. Collectively they catered to about 3000 patients. Table 9 shows a brief practice profile of the locations.

Practice Type	Practice Characteristics	Observership /Shadowing Time
Family Medical Centre	Provides comprehensive care to approximately 8000 patients 28000 to 30000 patient visits per year Affiliated with a University/Medical/Academic Institution Procedures include minor surgical procedures	5 x 4-hour block
Family Health Team	12000 to 15000 patient visits per year Serves immigrant population	2 x 4-hour block
Family Health Team	8000 to 12000 visits per year Services include mental health, diabetes, child health, etc.	2 x 4-hour block

Table 9. Practice profiles of observership/shadowing locations

3.3.4 « Questionnaire development »

In addition to consultation, observation and shadowing, I applied additional data collection approaches. One of the main findings from the process of observing and shadowing in real clinical setting was the realization of the dearth of information about use of regionally integrated EMR and the absence of validated instrument to collect data about the topic, hence, the need to develop a questionnaire. I designed a semi-structured questionnaire sent to primary health care and family physicians. The purpose of the questionnaire was twofold: to get responses about their experiences with the use and impact of EMR and to obtain a better understanding of their experiences with regional integration of EMR. According to Statistics Canada, a questionnaire is a group or sequence of questions designed to obtain information on a subject from a respondent (Statistics Canada, 2010, para. 1). Questionnaires are commonly used to collect survey data in an “organized and methodical manner about characteristics of interest from some or all units of a population using well-defined concepts, methods, and procedures, and compiles such information into a useful form (Statistics Canada, 2010b, p.1).

Items on the questionnaire were generated after consultation, observation, and shadowing, which provided indications as to the best content and formulation in the context under investigation. Essentially, careful observation of the situation coupled with findings from the literature review provided the main elements of question formulation and questionnaire development. Consultations provided expert opinion on recent developments that added new perspectives and clarity to enhance the questionnaire's ability to tap efficiently into the most important aspects of the study. Moreover, incorporating learnings from consultation, observation and shadowing helped to avoid the pitfalls of relying solely on the literature which may be biased and not in tune with the particularities of EMR use and impact in the region.

Questions and items were drafted based on information gathered from the above sources, assembled into a logical sequence and laid out in a clear and attractive format. Questions were organized to allow a sense of logic and naturalness emerge from the flow and sequencing. Questionnaire items were organized into three parts. Part one comprised of demographic information, part two asked about respondent EMR access and experience, part three consisted of questions about EMR use and impact. Completing and returning the study questionnaire was interpreted as an indication of consent to participate. Details of the questionnaire including questionnaire items, groundwork and sources that went into development of each item are available in Appendix C and Appendix D.

The layout was practical, with enough space provided for respondents to accurately select or record their responses. Skip pattern instruction was applied to items asking about EMR use in physician practice. For example, questions 7 and 8 included instructions for respondents to continue only if they answered ‘yes’ to having an EMR in their practice. Stapled pages with questions printed one sided to avoid extensive page flipping made it generally easier for respondents to manipulate and prevent inadvertent loss of pages. The questionnaire was tested and estimated to take about 20-30 minutes to complete. In completing the questionnaire, we requested that respondents provide frank and honest answers to serve as an invaluable expert resource for the study. They were informed that responses will be kept strictly confidential and the information provided will be used only in connection with the research.

An introduction to the study contained in a cover letter accompanied the questionnaire. Participants were invited to complete the questionnaire about the use and impact of EMR, informed of the purpose of the study; to evaluate the use and impact of EMRs in primary health care in South West Ontario and define the stages through which regional integration of electronic health information can be routinely assessed in the region. Potential respondents were informed that the study will examine EMRs and related health information resources in South West Ontario such as the regional clinical viewer ClinicalConnect, Hospital Report Manager, Patient Portals, Laboratory Information Systems, and Drug Information Systems.

3.3.5 Questionnaire validation

Having developed the questionnaire based on items deemed relevant to shed light on the use and impact of EMR in the region, the next step consisted of validating the questionnaire by testing with representative respondents to enhance the questionnaire's ability to tap efficiently into the most important areas of research interest. Despite consensus that pre-testing must be conducted during questionnaire development (Wolf et al., 2016) , there appears to be no agreed upon or systematic method of questionnaire validation. A review of literature from various sources suggests three to four phases in the process of questionnaire pre-testing or validation (Rothgeb et al., 2007). Preferably, the phases should be carried out sequentially with each phase resulting in modification upon which the next builds. However, due to time and budgetary constraints and considerations, the stages of questionnaire validation or pre-testing for this study were combined to run concurrently.

In the first stage of pre-testing, the questionnaire was presented to a group comprising of primary health care physicians and residents from the region who served as experts with knowledge of and expertise in the area of inquiry. Individuals with expertise in questionnaire development, questionnaire implementation or interviewing were also contacted to obtain feedback on language, length, flow and content coverage.

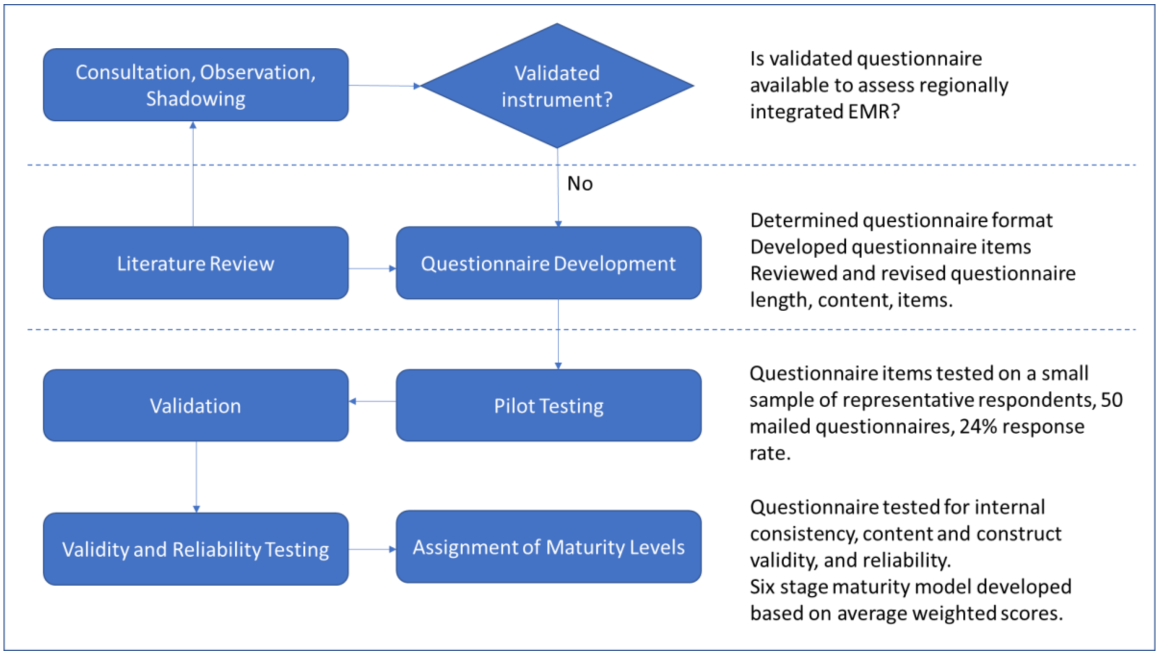

Figure 7. Questionnaire development and validation process

Consultations with subject matter experts served the purpose of content validation, to ensure that the relevant areas or domains of inquiry are adequately covered, and that necessary questions and items are included to permit satisfactory exploration of the phenomenon being examined. Questionnaire testers with expertise in questionnaire development and implementation also provided comments on appropriateness of questions, formulation and wording of questions, presentation of response formats and general layout or appearance of the questionnaire.

The second stage of pre-testing involved mailing the questionnaire to respondents' representative of the study population under conditions similar to those which actual respondents will respond in the actual study. We sent the questionnaire to a test sample of 50 randomly selected primary care physicians in the region. The pre-testing and pilot testing stages of the questionnaire occurred between January and May of 2017.Table 10 below shows the characteristics of pilot testers.

Demographics of questionnaire pilot testers, n=12	
Sex	
Male	66.7%
Female	33.3%
Age Group	
35 to 44 years	8.30%
45 to 54 years	16.7%
55 to 64 years	75.0%
Profession	
Family Physician	66.7%
General Practitioner	25.0%
Other	8.30%
How long have you had an EMR?	
4 to 6 years	50%
7 to 9 years	40%
More then 10 years	10%
How long have you been in primary health care practice?	
6 to 10 years	9.1%
11 to 15 years	9.1%
21 to 25 years	18.2%
26 to 30 years	45.5%
More than 30 years	18.2%

Table 10. Demographics of questionnaire pilot testers

Ambiguous and closely related questions were adjusted or combined to make language easily comprehensible and questionnaire clearer. Pre-testing indicated that respondents judged face value of questionnaire items and stated preferences for more specific questions than general questions. For example, pre-testers suggested adding a question about use of EMR for billing and scheduling, rephrasing questions indicating ability to use the EMR to reflect actual use of EMR, and making the final question specific on EMR impact (i.e. replace "*Is there anything else you would like to tell us about your EMR experience?*" to "*What is the most significant impact of EMR use on your practice?*"). It is preferable to have questions appear to be measuring what they actually are. Evidence suggests that respondents inherently strive for meaning and tend to modify questions that appear vague or incomprehensible into ones that are sensible to them (Lev and Ayalon, 2016). It is best to use simple language and familiar words without circumventing the goals of the research. Hyper-technical words or jargons that might not be easily understood in the context of EMR in primary care were avoided. Value-laden words and negatively worded items were not included to prevent asking loaded questions which do not allow for equal expression of all points of view that an item was meant to capture. Negatively worded questions were avoided because such questions might create confusion. Moreover, content and structure of the questions were examined to ensure one question was asked per item. A review of missing responses was completed as a way of assessing difficulties or ambiguities.

In the end, pre-testing allowed to detect problems, explore and apply alternatives to strengthen the questionnaire. After the revisions were made to the instrument, a final product was reviewed members of my thesis committee for final approval before questionnaire roll-out. The questionnaire can be found in Appendix C.

3.3.6 Sampling and recruitment

The target population for recruitment was practicing physicians working in primary health care in Southwest Ontario (approximately 3000). As the broader context of this research is the use and impact of regionally integrated EMR. I have selected to recruit participants from Southwestern Ontario because the region not only represents a delineated administrative or operational unit, it also has uniquely developed regional integration tools for EMRs.

The purpose of my strategy to sampling and recruitment was two-fold. First, to draw participants to the research. Second, to apply appropriate sampling and recruitment strategies that conform with methodological procedures characteristic of quantitative research and grounded theory studies, both of which constitute the mixed-methods research methodological approach employed. According to Thompson (2012), sampling "consists of selecting some part of a population to observe so that one may estimate something about the whole population" (p.1). Sampling, in simple terms, is the process or procedure of finding samples in a study. Samples refer to a group of people or things that are taken from a larger group and examined or questioned to obtain information. Despite the fact that sampling is an essential component of both qualitative and quantitative research, the sampling strategies used for each may be different. Coyne (1997) opined that sampling in qualitative research is not as rigidly prescribed as it is in quantitative research. In qualitative studies, especially grounded theory, sampling tends to begin purposely then theoretical. Purposive sampling (not to be confused with purposeful sampling) occurs when the researcher looks for information rich cases that can be studied in-depth, rather than studying every case in a large population (Coyne, 1997).

In the questionnaire phase, research participants were drawn from the population and identified from names and contact information publicly available in the 2016 version of the Canadian Medical Directory. 300 participants were chosen randomly with a geographical focus of southwest Ontario and defined by the four regional Local Health Integration Networks or LHINs which make up the connecting South West Ontario or cSWO cluster. This was done to make the research manageable and include individuals with a broad range of experiences with interests in and uses of the integrated electronic medical record. We replaced questionnaires that were returned undeliverable because some addresses in the Canadian Medical Directory were not up to date with new selection of participants to from the directory. Participants were recruited with the assurance of confidentiality. The decision to complete and return the study questionnaire was interpreted as an indication of consent to participate in the questionnaire phase of the research. Participants were recruited through a letter of information and consent inviting them to participate in this research study about the use and impact of Electronic Medical Records (EMR) and the regional integration of electronic health information in South West Ontario. They were informed that the study was part of a PhD thesis and the purpose was to evaluate the use and impact of EMRs in primary health care in South West Ontario and define the stages through which regional integration of electronic health information can be routinely assessed. The questionnaire roll-out phase ran between September 2017 and March 2018.

In the grounded theory phase, research participants were recruited based on the knowledge and experience they had about the topic under investigation through purposive sampling. However, as the data collected were analyzed and categories, emergent themes and the theory developed, initial purposive sampling evolved into theoretical sampling. According to Coyne (1997), purposive sampling is another phrase for selective sampling, arguing further that a researcher visits a particular research location and deliberately identifies participants for the study based on such criteria as research interest, time available to complete the research, research framework or plan, and other constraints or conditions within the context or environment of the research. In grounded theory, sampling is initially purposive and becomes more theoretical as the theory is constructed (Glaser, 2007). Participants are recruited based on the knowledge they have about the topic of investigation. As the data are analyzed and the theory develops, theoretical sampling may be used by the researcher to collect any additional data needed to enable wholesome and complete construction of the theory. Sampling purposively is a hallmark of grounded theory at the initial stages. Glaser (1978) as cited by Coyne (1997) states that researchers at the initial stages will approach the "groups that they believe will maximize the possibility of obtaining data and leads for more data on their question" (p.625).

The other kind of sampling highlighted in grounded theory literature is theoretical sampling. According to Charmaz (2014), theoretical sampling means "seeking pertinent data to develop your emerging theory" (p.193). The main rationale for theoretical sampling is to expatiate and refine categories that constitute the theory such that the researcher uses sampling to develop the properties of the categories until no additional properties emerge. The difference between the two types of sampling is the stage of the research process at which they are applied. While purposive sampling is usually applied at the beginning of the research process, theoretical sampling is subsequently useful to gather data for emergent categories as part of ongoing data analysis. This distinction is important because there have been situations where conflation occurs about the techniques of sampling in qualitative research literature (Coyne, 1997; Denzin & Lincoln, 2011). In this thesis, and as prescribed by grounded theory literature, after doing preliminary analysis of the data I collected, I conducted subsequent participant interviews with an eye towards obtaining more data and understanding about the emergent themes. For example, interviewees were initially drawn from the population and initially identified from names known to the principal investigator, Dr. Candace Gibson, with contact information crosschecked against information publicly available in the 2016 version of the Canadian Medical Directory. As the theme *'working through change'* emerged from preliminary analysis of the categories '*experiencing EMR transitioning*', '*transitioning as practice changing moment*' and '*working with hybrid medical record system*', it prompted data collection from family physicians in the region with unique experiences of changing EMRs or EMR transitioning since several were transitioning from Nightingale to Practice Solutions EMR at the time the research was conducted.

We made the decision to recruit these participants from South West Ontario for this thesis, recognizing that the lessons learned from this process will enable me or other researchers to attempt larger research projects in the future, perhaps with recruitment from several other regions with multiple experiences related to the use and impact of regionally integrated EMR.

3.3.7 Participant interviews

I used semi-structured interview method to collect more in-depth data about physician experiences beyond what was gathered during observership and shadowing, or with the questionnaire. Interviews are commonly used in grounded theory to gather data (Charmaz & Belgrave, 2012; Corbin & Strauss, 2012; Lingard et al., 2008). Compared to structured interviews, one of the main characteristics of semi-structured interviews is that they afford the researcher more flexibility and some leeway in adjusting and modifying questions based on responses of participants and evolution of the focus of the research. Lodico, Spaulding & Voegtle (2006) stated that an interview is considered semi-structured because the researcher can change the order of questions, omit questions, or vary the wording of the questions depending on what happens at the interview. In addition, the authors indicated that even though semi-structured interviews are flexible, it is important to identify topics to be covered in advance. Charmaz and Belgrave (2012) advised that interview questions should be appropriately general enough to cover a wide range of experiences and narrow enough to elicit and explore the unique experiences of interviewees. Usually, semi-structured interview questions are pre-formulated in an interview guide. The purpose of the interview guide, as the term suggests, is to serve as a guide for the questions (both closed and open-ended) to be asked by the researcher in the interview. Corbin and Strauss (2008) and Charmaz (2014) indicated that a detailed interview guide is not always necessary in grounded theory research and that the richest data can emerge from less structured interviews. My interview schedule contained a script that I read to interviewees prior to each interview thanking them for participating and explaining to them the purpose of the study and approximately how long the interview would take. A copy of the interview schedule is available in Appendix xx. Participants were invited to review the consent form and asked if it was okay to record the conversation. Signed consent form was obtained from each interviewee because the terms of ethics approval for recruitment for data collection required that I obtained permission directly from participants.

My interview guide evolved over the course of the data collection process from general to specific questions. Under each of the main topics of inquiry, I had subsequent questions with follow-up probes to support conversation with the physician. For example, under the main question about integration tools, my interview schedule read as the initial question, "*Could you describe your experience with EMR integration tools currently used in your practice?"* with the follow up probes "*What kind of information do you most frequently access or retrieve using ClinicalConnect/Hospital Report Manager/Ontario Lab Information System?*", "*How easy is it to find information in ClinicalConnect/Hospital Report Manager/Ontario Lab Information System?*", "*What challenges to use do you experience with ClinicalConnect/Hospital Report Manager/Ontario Lab Information System?"*. My interview guide was routinely reviewed by my thesis supervisor and modified to accommodate emergent themes from the grounded theory procedure. I interviewed respondents in two rounds to allow for analysis, categorization and emergence of themes in line with grounded theory procedures. I scheduled interviews for a time and location that was convenient for each of my participants, most of whom were able to participate at their clinic during lunch hour, others were available after hours on weekdays or at the clinic on weekends. My participants did not receive an honorarium. Twenty-four individuals were ultimately recruited to participate in semi-structured interviews, conducted to gather data for an in-depth analysis of respondents' experience with regionally integrated electronic medical record and their views of the benefits and detriments of electronic medical records. Twenty-two of the twenty-four interviews were audio recorded. The interviews were conducted iteratively from March 2017 to February 2018 with follow-up interviews running to May 2018. I relied on my notes regarding the conversation for non-audio recorded interviews and follow-up interviews, as well as for the memoing procedure characteristic of grounded theory inquiries. Upon advice of my thesis supervisor and principal investigator, I used the services of a professional transcription company with secure, confidential server, well known to researchers at Western University and previously used by my thesis supervisor and principal investigator, to prepare the audio recordings into verbatim, electronic documents. Transcripts were anonymized to prevent person identifiable information from appearing on the transcribed documents. The original recordings were erased from the portable audio recording device used to record the interviews. Transcripts were reviewed to screen for accuracy and uploaded for analysis to versions 11 and 12 of qualitative analysis software NVivo by QSR (QSR International, 2015).

3.4 Data analysis

Both qualitative and quantitative analytical tools and techniques were used in line with mixed-methods and grounded theory approaches to data collection. According to Shamoo & Resnik (2009), data analysis involves the systematic application of statistical and/or logical techniques to reduce and transform data to produce useful information and draw valid conclusions (Shamoo & Resnik, 2009, 2015). Corbin and Strauss (2008) stated that analysis "involves examining a substance and its components in order to determine their properties and functions, then using the acquired knowledge to make inference about the whole" (p. 45). These techniques provide a way of drawing useful inferences from data (Shamoo & Resnik, 2015).

3.4.1 Quantitative data analysis

All quantitative data analyses were performed using SAS version 9.4 (SAS Institute, 2012) and IBM SPSS software package, version 25 (IBM, 2017). Descriptive statistics were calculated from responses to questionnaire items and summarized into frequencies and percentages.

3.4.1.1 Maturity model construction[1]

A six-stage maturity model was developed that provides a framework to describe key elements of operative EMR use within the context of regional integration of electronic health information resources. Rather than assessing EMR maturity based on ad-hoc processes from immature to mature levels, it characterizes and structures maturity levels by results of the survey based on actual EMR use which reflects needs of physicians and patients. To construct the maturity model, responses to questionnaire items were organized into six stages representing high, mid-range and low scoring items in terms of respondent percentages.

3.4.1.2 Test of differences

Tests of differences were conducted to analyze the relationship between the stages of the maturity model and key characteristics of respondents. Although there could be other key factors that may influence maturity stage, the variables tested were chosen to keep the

---

[1] The principal investigator's approach to map questionnaire items directly to a model based solely on participant responses was a decision was made without input from the advisory committee or solid methodological basis. I made multiple attempts to present alternative options and invite expertise on maturity model development but was repeatedly overruled, sometimes with visceral reaction. I had to conclude that barring some unknown, underlying reasons, this was not an oversight, the principal investigator truly believed it was sufficient to map questionnaire items directly to a model without clear elaboration of how concepts evolved into questionnaire development and further into model construction. A viable approach that I proposed which was overruled was to develop a framework consisting of questionnaires for each maturity scale along with structured rating method with pass threshold for each maturity level. I look forward to exploring such alternative approaches in future research.

scope of this study within regionally integrated EMR and physicians' points of view. In particular, we examined the effect of independent variables (sex, years in primary care practice, years of having EMR, location of practice and how physicians rate their EMR) on EMR maturity level.

Pre-defined maturity levels or stage1 to stage6 from the questionnaires which were already coded as a group of 5-point Likert score questions and were treated as ordinal variables. Therefore, for group of Likert-type questions per stage, the median of scores per observation was calculated. This resulted in six separate ordinal, Likert-type variables for stage1 to stage 6 which served as six separate outcomes for the analysis.

Considering the small number of observations in the current research, it was of vital importance to avoid multicollinearity among independent variables as much as possible. Multicollinearity refers to linear relation among two or more variables which may cause difficulty in reliability of estimates (Alin, 2010). Therefore, Spearman tests of correlation between independent covariates were examined before carrying out the main analysis. Spearman's Rho is a non-parametric test used to measure the strength of association between two variables, where the value r = 1 means a perfect positive correlation and the value r = -1 means a perfect negative correlation (Jackson, 1980).

Kruskal-Wallis test, also referred to as the "one-way ANOVA on ranks" is a rank-based nonparametric test that can be used to determine if there are statistically significant differences between two or more groups of an independent variable on a continuous or ordinal dependent variable (Ashcroft et al., 2003; Gooch, 2011; McKight & Najab, 2010). In this test, a significance level of 0.05 indicates a 5% risk of concluding that a difference exists when there is no actual difference. If the p-value from test result is less than or equal to the significance level, we reject the null hypothesis and conclude that there is a strong, significant Kruskal-Wallis test difference. Wilcoxon-Mann-Whitney rank-sum test was used where independent variables had two levels (i.e. sex or gender) and the dependent variable was ordinal and had more than two levels (i.e. six stage maturity levels). Kruskal-Wallis test of equality of proportions was used where independent variables had more than two levels (i.e. years in primary health care practice, location of practice, how physicians rated EMR in their practice, and how long a physician has had an EMR) and the dependent variable was ordinal and had more than two levels (i.e. six stage maturity levels).

Null hypotheses examined the relationships between each of the covariates with stages of the maturity model. The hypotheses are as follows.

1. The distribution of the stage of EMR use maturity model is different by years in primary health care practice.
2. The distribution of the stage of EMR use maturity model is different by location of practice, operationalized by Local Health Integration Network (LHIN).

3. The distribution of the stage of EMR use maturity model is different by how physicians rated EMR in use in their primary care practice.
4. The distribution of the stage of EMR use maturity model is different by how long physicians have had an EMR in their practice.
5. The distribution of the stage of EMR use maturity model is different between male and female.

3.4.2 Qualitative data analysis

In total, I interviewed twenty-four primary health care physicians in the region. In terms of demographics, ten interviewees were female and fourteen were male. Four interviewees have been practicing in primary health care for forty or more years, while the years of practice of the remaining twenty ranged from three to thirty-four years. Only one had been using an EMR for longer than twenty years.

3.4.2.1 Coding, memoing and constant comparison

The data were organized and then coded with the assistance of Nvivo Versions 11 and 12.2 (QSR International, 2017, 2018), a computer aided qualitative data analysis program to assist me in managing, querying, and storing the research data (QSR International, 2015).

Coding is an essential practice in qualitative research as a process of “categorizing segments of data with a short name that simultaneously summarizes and accounts for each piece of data” (Charmaz, 2006, p. 43). Bazeley (2007) described coding as a way of “organizing and indexing segments of text from multiple data records in a way that facilitates the development of categories” (p.66) and, by extension, development of concepts. In the coding process, the researcher selects, separates and sorts the data to determine what the data is about and then assigns labels as data representative codes (Charmaz, 2006, p.45). In grounded theory, the coding process helps define what the data are about which may take the researcher to unexpected or unforeseen areas that enable the construction of an emergent grounded theory. Compared to quantitative research, coding in qualitative research generally, and in grounded theory specifically, involves iterative activities aimed at confirming emergent codes. Codes are developed and revised throughout the process of data collection and are means of obtaining theories or descriptions of the phenomenon being investigated. According to Strauss & Corbin, (2008), data analysis involves “taking data, thinking about it, and denoting concepts to stand for the analyst’s interpretation of the meaning intended by the participants” (p.85). They further described the process of initial data review ad categorization as open coding.

I coded a category that captures the experience of working through change as ‘transitioning’ emphasizing the action of experiencing or going through changes in the use of EMR, rather than the perhaps the more intuitive topical concept of ‘transition’. Coding with gerunds portrays the use and impact of EMR as possibly an action, a process or a decision. As Charmaz acknowledges, coding may be difficult at first, but it allows us to see processes that may have been invisible with a cursory look.

I began the process of analyzing my qualitative data once each interview was completed, listening to the interview in its entirety and checking on the accuracy of transcription. After reading the transcribed document in its entirety, I did line-by-line reading and coded the recorded information into categories based on both the interviewee language and my own words from my interpretation of what was said. One may argue that the approach to determining coding reliability as a measure of quality is very different since grounded theory methodology emphasizes reflexivity, theoretical sensitivity and circular testing of codes as key strategies to ensure quality. As the primary data analyst, I discussed my initial coding with my thesis supervisor and principal investigator and continued to check with her as my work progressed. I applied the tenets of intra-coder reliability or the extent to which the same coder conducts the coding process in a stable way over a period of time (Song et al., 2012) by coding the interview transcripts three different times over a period of several months. As a result, some codes were revised while maintaining consistency of meaning and interpretation. This is consistent with analytical approaches described by Kathy Charmaz in her book *Constructing Grounded*

Theory (Charmaz, 2014), in which the author detailed her approach to grounded theory analysis. Charmaz's approach involves such steps as initial coding, focused coding, and theoretical coding. Initial coding can be accomplished in three ways: word-by-word, line-by-line, or incident-with-incident, and the type of initial coding applied is dependent on the type of data being analyzed (Charmaz, 2014). In analyzing my interview data, after applying line-by-line coding, I used incident-with-incident coding in the initial coding phase. Incident-with-incident coding is similar to line-by-line coding (Charmaz, 2014, p.128) except that similar statements are compared and applied to similar codes. After the initial codes were generated, I applied focused coding which, according to Charmaz means "using the most significant and/or frequent earlier codes to sift through large amounts of data" (2014, p. 138), adding that this requires deciding which codes from the initial coding stages "make the most analytical sense to categorize your data incisively and completely" (2014, p. 138). It involves further abstraction of the initial codes and is intended to sort data by analytical levels rather than merely summarizing or attaching topic labels to interview data.

An important component of the analytical process is memoing. Holton (2010) described memo writing as a "parallel process with the coding and analysis of data to capture the researcher's emergent ideation of substantive and theoretical codes and categories (p.32). Morse & Richards (2007) described memos as "informal notes recorded by the researcher throughout the research process to enable the researcher's reflection on the analysis of data, by recording ideas, discoveries, impressions, descriptions, and context" (pp. 113-114). Memos can be seen as notes about the data that enhance development of conceptual connections between categories. Weighing in on memo-writing in grounded theory, Charmaz (2006, p.85) added that writing memos is an ongoing process that helps researchers to analyze ideas about the codes, identify gaps in data collection, develop certain codes into categories, and to demonstrate relationships between emerging categories.

During this study, I used electronic and paper-based notes to write down my memos, which were organized by interview date. I also took advantage of the qualitative analysis tool, Nvivo as a more efficient way to easily access my memos when needed during analysis. Furthermore, I categorized my memos into five areas or categories for analytical purposes. My observation notes (ON) were detailed notes about what I saw, heard, felt during the data gathering process. Methodological notes (MN) included notes about how to collect data, notes about who to talk to, when to make phone calls or return calls, plans for scheduling interviews and travel, emailing, etc. My theoretical notes (TN) captured my interpretations, hunches, critiques, hypothesis about what I was doing, thinking, seeing, etc. My conceptual notes (CN) were analytic notes comprising of my interpretation and combination of theoretical notes, mainly during the analysis stage.

They included notes about similarities, differences, associations between and among contents of theoretical notes and interpretation of coded data. Finally, my personal notes (PN) comprised of notes about my feelings about the research process, who I was talking to, anxieties, fears, pleasures, etc. Categories and samples of my analytic memos can be found in the Appendix.

Grounded theory research depends on using constant comparative methods and the researcher's engagement (Charmaz, 2006, p. 178) by making continuous comparison between data, codes, and categories, to facilitate analysis. Early grounded theorists such as Glaser & Strauss (1967) described using constant comparative methods to establish analytic distinctions and then make comparisons at each level of analysis. Doing constant comparisons enabled me to refine my conceptual understanding of the characteristics of the codes and categories generated during this research. Since my coding continued alongside data collection, I continuously considered new information in light of data collected during previous interviews. I compared some interview statements and incidents within the same interview, and then compared them with other incidents and statements in previous interviews. This comparison continued when new interviews were completed, and new data collected. This iterative process allowed me to organize my codes into themes around central categories from various interview sources. The resulting emergent themes, categories and sources allowed me to determine when the process has reached saturation. Corbin and Strauss (2015) stressed that hypothetically, a researcher "could go on collecting data forever, adding new properties and dimensions to categories”(p.140), ultimately the researcher “has to accept that they have gathered enough data to support the purpose of their research (p.140). At such point, grounded theorists agree that the researcher reaches saturation and theory begins to emerge (Bryant & Charmaz, 2007; Charmaz, 1995, 2006; Glaser & Strauss, 1967; Strauss & Corbin, 1998).

I routinely discussed the depth of my data collection and analyses with my thesis supervisor and after 24 interviews, we sensed that the data analyses had evolved to such a state where themes were sufficiently developed to support my understanding of interviewee perspectives, and that additional interviews were not likely to add major changes to the understanding of data collected during the qualitative phase of this research. Hence, theoretical saturation was reached at which point additional interviews were deemed unnecessary with new participants. I didn’t deem it necessary to member check recorded interviews partly because having transcribed documents allowed more in-depth attention and analysis, and partly because researchers have argued that there is little evidence that member checks actually improve the quality of qualitative research aimed at theory development (Koelsch, 2013; Thomas, 2017).

3.5 Research considerations

Research with considerable qualitative component benefit from application of certain evaluative criteria and research considerations. Grounded theory studies are often evaluated differently from other qualitative or quantitative studies. For example, Strauss and Corbin (1990) (cited in Creswell, 2007) highlighted useful research considerations and criteria for evaluating studies by asking the following key questions.

1. Are concepts generated?
2. Are the concepts generated systematically related?
3. Are there many conceptual linkages and are the categories well developed? Do they have conceptual density?
4. Are many variations built into the theory?
5. Are the broader conditions that affect the phenomenon under study built into this explanation?
6. Do the theoretical findings seem significant and to what extent?

In addition to the above stated evaluative criteria, the following eight “big-tent” criteria for quality by Tracy (2010) provided a basis for making empirical decisions in this thesis. Both served as an informal checklist for the research process.

3.5.1 Eight “big-tent” criteria for quality

This study used the eight “big-tent” criteria (Tracy, 2010) to assess quality and evaluate the qualitative component of research.

Worthy topic

Not much is known of the experiences of primary care physicians in south-west Ontario from the perspective of regionally integrated EMR. This study prompts the readers to ask themselves “what it might be like to work in a fully integrated EMR environment?”, “what are the experiences that a primary care physician goes through while using integrated EMR?”, “to what extent do physicians utilize EMR integration tools?”, or “what are their experiences with electronic health information and impact of EMR use on healthcare services that are provided to patients?”. Through in-depth interviews of their experiences, this

study provides a glimpse into the typical daily use, benefits and drawbacks from unique perspectives of physicians. The topic was timely as several physicians were undergoing changes to EMR use. The topic was also relevant, significant and interesting to EMR users, not only those who participated and were engaged from the region, but also people anywhere EMR is being used as enabler of quality patient care.

Rich rigor

Maintaining rigor is an important aspect of any research study, including digital health research. Tracy (2010) ascribed rich rigour to having adequate, rich and appropriate theoretical constructs, data and time in the field, sample, context and data collection and analysis processes. Despite small sample of the quantitative component, the rich rigour of the qualitative component enhanced the robustness of analyses and findings of this research because various measures were taken to ensure that the study was rigorous in nature. Rigour was ensured by always keeping in mind the purpose of the study, and always basing interview questions on the experiences of the participants. Twenty-four interviews were conducted with the participants to ensure richness of the data was captured. Adhering to the grounded theory viewpoint, the types of questions asked were semi-structured and to a large extent, open-ended and descriptive in nature. To ensure data accuracy, most of the interviews were audio-recorded, transcribed verbatim and reviewed to ensure that no details regarding their experiences were missing. Observational, theoretical and reflexive notes were also taken during the data collection and analysis process.

Sincerity

According to Tracy (2010), sincerity relates to the ideas of authenticity and genuineness about the researcher's "biases, goals and foibles as well as about how these played a role in the methods, joys, and mistakes of the research" (p.842). Transparency about the methods and challenges was important while negotiating access to family physicians with busy schedules. Self-reflexivity was important at every stage of the research as it allowed the researcher to be forthright about how the strengths and weaknesses of the research process, and the role that the researcher played in influencing the outcomes of the research, eventually revealed the overriding story and set of themes grounded in the research data.

Credibility

Through the rich descriptions of the experiences relayed by the participants, I was able to discover and gain a deeper understanding of some of the challenges that physicians and their patients encounter, the type of information resources and services that they use, as well as their knowledge and understanding of the role of digital health. The participants provided rich and concrete details or as, Tracy (2010) puts it, “thick description” (p.840) of their EMR use. In certain situations, during the research process, they showed rather than just told. Showing how they used EMR allowed me to be immersed in the concrete details about unarticulated and contextual understanding of their experiences. One does not often think of the impact that mundane aspects of technology use such as changing an electronic tool, could have on their working lives as physicians. For many of the participants undergoing EMR transitioning, the experience can be quite restricting as it forces them to adapt to different ways of recording and accessing information about patient encounters. Semi-structured interviews allowed the participants to talk freely of their experiences and for me to obtain rich, detailed descriptions including non-verbal communications.

Resonance

This study provides opportunities for transferable findings from deeper understanding into the reality of EMR use applicable in various health care organizations. Through this research, I attempt to present research that resonates with a variety of digital health users who find significant parallels to the experience of participants. For example, by taking small instances of individual experiences of participants and placing them within a larger frame, readers may vicariously reflect on the role of changes or transition in their own experiences, and how such transitions interact with issues of power and influence of external forces and players on routine daily experience of technology use.

Meaningful coherence

Tracy (2010) described meaningfully coherent research as one that achieves its stated purpose, applies methods and procedures that align with the stated purpose, and meaningfully links pertinent aspects of the research such as research question, findings, literature and interpretations. By interconnecting observership and shadowing component with the qualitative and quantitative components, this research ensured that the research foci link up both with the methodologies and findings to justify the importance of the study in filling current gaps in EMR research stated at the beginning.

Significant contribution

This research examined key issues of regional integration of EMRs in the context of primary health care. Since EMRs are fundamental components of electronic health information resources available for use in primary care and are gaining increasing importance in light of the critical role they play in supporting delivery of care, the significance of this research is gauged not only by addressing research gaps, but also through developing theory and maturity model and offers new and unique understanding that emerge from data analysis within a unique regional context. The research is particularly applicable to solo and group practice physician offices, family health teams, walk-in clinics, community health centers, community care access centers and hospitals. Considering many of the concerns regarding needs, adoption, use and impact of electronic health information brought to light by previous studies, the contribution of this research in examining EMR use and impact from the perspective of physician users is particularly significant.

Ethical considerations

Tracy (2010) suggested that researchers should consider ethics not only as a means, but as “universal end goal of qualitative quality” (p.846). Ethical processes and procedures applied in this research are provided below.

3.5.2 Ethical considerations

Ethical issues and considerations were addressed at each phase of the study in compliance with regulations of participating institutional ethics review boards, mainly Western University's Delegated Health Sciences Review Board for the overall research, and London Health Sciences Research Ethics Board for the observership and shadowing phase of the research. For example, informed consent form for the interview phase, contact messages and letters of information were developed which clearly stated that the participants were guaranteed certain rights, agreed to be involved in the study, and acknowledged their rights were protected (see Appendix). Initial contact with potential interviewees were made through email, letter mail and telephone calls, where possible. Verbal consent to take part in the interview phase was obtained. The initial contact email or phone calls were followed up by a package of information provided before the commencement of interviews. This information package included an information letter with pertinent information about the research and the interview, and to obtain written consent from the interviewees for the interview to proceed. A consent form was completed and returned to the researcher. The letter/message also confirmed the time and date of the interview. A sample copy of the information letter/message can be found in the Appendix, and a sample list of the main interview questions is equally in the Appendix. If a written consent form has not been obtained by the researcher prior to the scheduled interview, one will be brought to the site so that it can be signed before the interview took place. If participants indicated concerns regarding confidentiality, there were several options available to them; they could choose not to participate, choose to refuse to answer a question, choose to not have the interview recorded, and they could decide to withdraw from the interview at any point.

The audio recordings of the interview, written notes and reports, as well as the analysis, were kept in a locked file cabinet and/ or in a password protected electronic file at the researcher's office. When the research activities were completed, all files will be not be retained by the investigator. Future access by other researchers to interview material will be not be granted even if consent has been obtained from the interviewee.

Chapter 4

4 Findings: Observership and shadowing phase

4.1 Introduction

Findings from my observership and shadowing sessions are presented below.

One of the top four EMRs used in the region (Nightingale, Practice Solutions, Oscar, Accuro) is typically selected as the primary care information system after extensive request for proposal and selection process. For example, in 2010, one of the practices selected Nightingale, a workflow based EMR for practice medical records management tool. The other two use used Practice Solutions and Accuro EMR.

The physicians and patients I encountered all seemed much more comfortable with my presence as an observer than I expected. Initially, I expected to be invisible, with my focus entirely on the screen, watching how the physicians interacted with the EMR. Over time, particularly during patient visits, my attention focused more on patient-physician interaction while using the EMR. The EMR allowed physicians to record patient encounters accurately, yet it was easy to see how such a system could be ill-equipped to handle the complexity of a primary health care practice's day-to-day activities, with potential for chaos at the point of care, especially during events of system or power failure, which happened during my observership. I realized that perhaps even greater than the EMR's opportunity to enable and improve physician's care delivered to patients was its potential to interfere with patient care. The EMR should not get in the way of patient care.

According to shadowed physicians, EMR adoption program was overseen by Ontario MD, which took charge of certification and standards and provided incentives such as a $30,000 adoption incentive over three years, and continuation of monthly funding for EMR adoption for a limited time period. OntarioMD is a wholly owned subsidiary of the Ontario Medical Association, funded by the Ontario Ministry of Health and Long-Term Care. OntarioMD supports physician practices in the selection, implementation and adoption of electronic medical records (EMRs) and other digital health tools. Health Quality Ontario supported standards, data cleaning and quality for the Family Health Teams.

Laboratory information was managed and maintained within Ontario Lab Information Services (OLIS). Medical teams were connected to the local hospital information system, such as Cerner PowerChart (a clinical component of electronic information system at the hospital). The EMR, while connected, was different from the hospital information system and not fully interoperable. As of the time of observership and shadowing, Hospital Report Manager (HRM), developed by Ontario MD, enabled clinicians to securely receive patient reports electronically from participating hospitals and specialty clinics. It was mainly a ‘push system’ that delivered text-based medical record reports such as discharge summaries and transcribed diagnostic imaging reports from participating facilities directly into patients' chart, within the clinician's EMR. An assessment tool was being integrated into the system at the time of this observation. A patient portal currently does not exist in the EMR but there is a plan underway to integrate a patient portal into newer versions of Nightingale, which will include telemetry, tele homecare, allowing patients to enter data from tablets, for example, through Apollo software. There is need to integrate multimedia features and capabilities.

One of the practices took part in integration projects such as EMR researchable repository project to support quality and standards called the DELPHI (Deliver Primary Healthcare Information). DELPHI established a researchable database derived from data pooled from the EMR of ten primary health care practices throughout southwestern Ontario and was the first Canadian primary care EMR-derived database to apply the International Classification of Primary Care on a subset of patient encounters. Other projects include the C3 Project (Connecting the Continuum of Care) and HealthLinks for people with chronic conditions such as congestive heart failure, COPD, diabetes, involving interviews with patients at home, community care meetings and patient meetings to incorporate care plans, patient values. Additionally, eHealth regional integration efforts included Community Care Access Centres (CCACs) using the Client Health and Related Information System (CHRIS), accessed through ClinicalConnect.

The observership revealed that challenges of integration persist. Electronic Medical Records and Electronic Health Records have improved significantly over the years in terms of scheduling, billing and routine functionality (such as generating a cumulative patient profile). However, linking a patient's encounter with lab reports in ways that are searchable is still a challenge as reports are often presented as PDFs without unique requisition identification numbers. While information from the Hospital Report Manager (HRM) populates seamlessly, information from outside of the (HRM) has to be scanned into the system. Depending on the particular EMR system and practice setting, features such as eRequisition, eReferrals and eConsults aren't fully integrated. Pictures (say, of a patient's rash) can be taken in some EMR systems but cannot be attached to or searchable on the patient's encounter without workarounds by a skilled super user, which may lead to increased system vulnerabilities. During the observership, the EMR system was down leading to disruption of services and backlog of work as physicians and residents had to spend additional time on note taking on paper – and how was that later incorporated into the record. A few patients who kept and wanted to share their personally-kept medical history could only use print outs and email.

4.2 Typical daily regionally integrated EMR use

All observed physicians indicated that everyday use of the EMR improved documentation, tracking and legibility of notes. Moreover, using regional integration tools such as HRM enabled them to securely receive reports from participating sending facilities, to which they otherwise would not have access. To describe how the observed physicians typically use regionally integrated EMR, I have organized my shadowing experience into three sets of observations; EMR use before patient visit, EMR use during the patient encounter, and EMR use after the patient visit.

4.2.1 EMR use before patient visit

Observed physicians typically prepared for a patient visit by viewing EMR tasks and to do lists. They can assign tasks to themselves, to other specific staff such as administrative staff, to other physicians, nurses or allied health staff on the team. Tasks previously associated to a patient chart served as a starting point to the patient visit because they indicate who requested the tasks, action needed, what the tasks concerns and the due date. Overdue tasks are presented in red to indicate urgency and in need of attention. Tasks could require action such as booking appointment for lab, sending referral, etc.

After checking the to do list and items needing a review, observed physicians often open a patient chart or search for the name to pull up the patient chart. There are two major parts to the patient chart – the Cumulative Patient Profile or CPP and the Encounter. The CPP is used to keep the record of a patient's relevant medical history while the Encounter is used to capture information about the patient visit. The CPP is useful for recording the past medical history of new or transferred patients for whom a new chart may be created.

Information recorded during patient visit such as procedures, immunizations, injections are automatically updated in the CPP. Historical record of patient's history that has been accumulating over time could result in a very large CPP. EMR included features that allow physicians to archive data that is no longer required on the active CPP such as medical problem that has been resolved by moving to past history or archive. This frees up space on the CPP and makes it easier for the physician to record new problems in the chart. In addition to past medical history, the CPP includes information on allergies, problem lists, medications, injections, immunizations, family history, social history (hobbies, stressors, alcohol, drugs, tobacco), consultations, alerts and reminders.

4.2.2 EMR use during patient visit

Observed physicians typically explained to patients that I was there to observe them using the EMR system for research purposes in the hopes of better understanding the use and impact of such systems and improving the experience for physicians, and by extension, patient care. Researchers tend to be removed from the experience of patients and clinicians despite a general understanding that shadowing experience might be beneficial, not only to researchers but also to developers.

EMR use during patient visit generally involved recording clinical notes about the services provided to and interaction with the patient. Observed clinicians kept record of the reason for patient visit, services provided during the visit, issues addressed in the course of patient visit, record of medications prescribed, renewed or discontinued, referral information such as referral letters to internal or external consultants. They used the EMR to create laboratory and other test requisitions, and to keep track of patients for recalls, follow ups or special care plans.

EMRs in observed physicians' offices had several options for selection of type of location where the patient visit occurred with the default location set at the doctor's office because most encounters were made in person at the clinic. A patient visit captured in the EMR could potentially be made at home, over the phone, at a satellite location, on the street (in case of accidents or outreach), or at other locations. Duration and intensity of EMR use during patient visits vary by physician, I could discern the type of EMR user during the observation by minimal or continuous EMR use. The minimal user summarized encounters in short typing sessions and would stop when the patient spoke. The continuous EMR user typically faced the patient using cues such as nodding and eye contact to assure patients of attentiveness while continuing to type. The layout of the room and position of the computer relative to the patient and the physician facilitated visual contact.

The extent of use of EMR by the physician during patient visit appeared to be related both to the reason for visit and the initial behavior of the patient. For example, I noticed that patient visits related to mental health and psychological issues were generally longer in duration and physician use of the EMR minimal compared to other types of patient visits. Use of EMR during patient visits related to physical examination appeared to be sequential in relation to the stages or steps in the physical examination process.

Some patients keep track of their own health information. One patient used Excel spreadsheets to summarize and keep track of their own encounter and brought the information to share with an observed physician. Another patient who came to physician appointment with a care giver also kept personal record of the encounter. Patients bringing own information didn't appear to be concerned about privacy or security of personally held medical information. These patients appeared to be confident both about sharing information with the doctor and keeping own health information secure and private. This could be an indication that patient access to personal health information may not be as much of a problem in the view of patients. In these two observed cases, patient's own information was not integrated into the physician's EMR.

Patient reason for visit could be preventive, chronic, routine check-up, care-giver initiated, for mental health issues, and was captured with ENCODE-FM, ICPC, or ICD coding systems. PS Suite EMR supports SNOMED CT in addition to ICD standards of international codification. All observed physicians input most visit notes during the patient encounter and often shared EMR screen with the patient as they deemed necessary. Shadowed physicians typically use the search menu of the respective EMR to search for and select diagnostic codes. Coding systems such as ENCODE-FM are hierarchical, comprise of levels with each level being more refined in detail and description. Physicians select diagnosis codes based on the most refined level appropriate for the patient visit or level of detail in the diagnostic description. Some physicians create favorite lists of the codes that they use the most to record encounters during patient visit. Figure 8 shows screenshot of sample EMR diagnosis code search in Nightingale EMR.

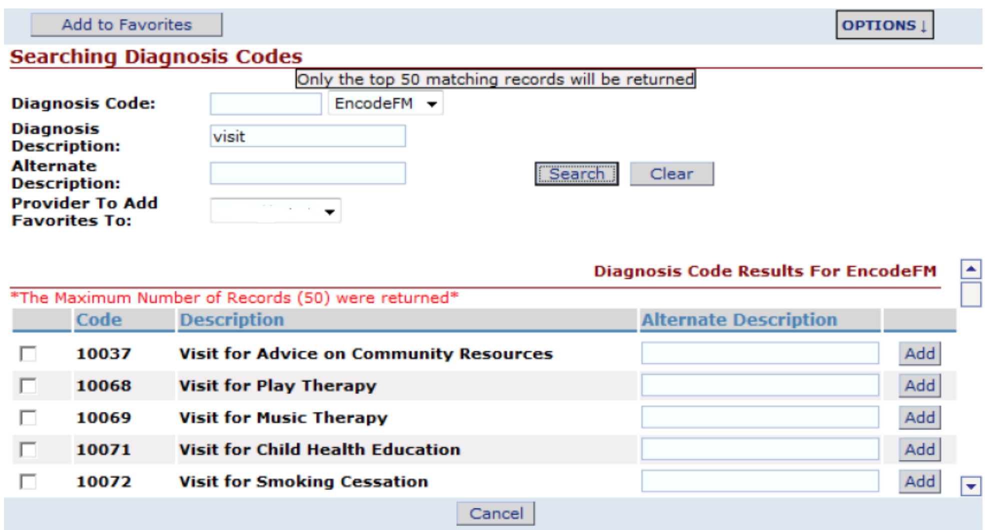

Figure 8. Screen capture of Nightingale EMR

Documentation and charting sometimes involved conversation with colleagues and trainees, conversation with nursing staff and clinical assistance staff. Observed physicians often checked with colleagues in the process of completing the CPP, medical history and follow-up notes, orders for tests, test orders sent electronically, lab results, patient demographics, and imaging results. Some of the physicians and their colleagues are considered ‘super users’ responsible for creating and maintaining practice specific templates to help enter subjective/objective clinical findings or mandatory fields much more easily. Physicians used EMR templates such as problem lists and allergy lists to improve documentation because problem-specific templates allowed them to, as one observed physician put it, “conduct better analysis of clinical information in standardized, reportable formats”. Often, colleagues help lighten significant workload on the physician when tasks such as messages from patients, basic interpretation of parts of test results, basic questions and requests from nursing homes or referrals can be triaged or handled by other members of the clinical team.

4.2.3 EMR use after patient visit

Majority of work associated with patient visit was done and information captured during patient visit although observed physicians tackle their work in different ways. Some wait until after patient visit to complete notes or at the end of the clinic day to review notes before signing off on them. In the back office, physicians would review notes from the visits and may expand on them, filling out details and referencing reports reviewed earlier in the EMR in the examining rooms. In all the practices, the EMR is integrated and accessible such that updates are made synchronously regardless of the location of information input.

4.3 Summary of key observations

4.3.1 Awareness, training, and engagement

At certain points during observation and shadowing I asked whether the physicians thought regional integration tools in the EMR were good products, and if they thought tools such as HRM and ClinicalConnect helped them provide better care, to which they typically replied in the affirmative while conceding that there was need for improvement.

ClinicalConnect served as an intermediary connection point between South West Ontario area hospitals in particular and hospitals in Ontario generally with HRM. Hamilton Niagara health system was the first hospital network in the region to send reports through HRM using the ClinicalConnect. I observed physicians using Nightingale access the web-based report viewer., one of the two main components of ClinicalConnect (a web-based report viewer and an EMR download service). The download service allowed these physicians to electronically download patient information from ClinicalConnect, such as blood bank, lab, microbiology, transcription and radiology reports from hospitals into the EMR in the practice. Physicians using Practice Solutions didn’t particularly appear keen on using ClinicalConnect, and in some situations, were not aware of the kinds of data they could access through ClinicalConnect. As HRM is a provincial report delivery system and all practices and centers in the province were being enrolled for HRM, all observed physicians were aware and have used HRM. ClinicalConnect was viewed more as a complementary tool to HRM by some, while others exclusively use ClinicalConnect to access HRM and other integrated tools.

Physicians did not express concern about the security of the data in the HRM because reports were only sent to a patient's identified provider as valid recipient of the patient's report. For example, if a physician is identified as the valid recipient for a report by a hospital, the report would be delivered to that physician regardless of whether the physician was the ordering physician or family physician. One physician indicated that nurse practitioners can register and serve as valid recipient of patient report. Each practice can map reports and determine what report categories to configure for filing.

4.3.2 Unidirectional data flow

HRM was identified as a push system which delivered text-based medical record reports such as discharge summaries and transcribed diagnostic imaging reports from participating facilities directly into patients' chart, within the clinician's EMR. The key benefits of HRM to clinicians and patients include improvement of continuity of care when a patient received care from a hospital or other sending facilities such as community health centers by allowing clinicians to follow-up with patients more quickly as they received the reports sooner than they used to. However, patient information cannot be sent from the EMR to the HRM. A push-pull system would be more ideal for the kinds of daily encounters with patients that observed physicians regularly get involved with.

4.3.3 Data tracking

Some physicians expressed concern about generating timeliness reports from data miner in Nightingale to track when certain reports such as ER reports are available through HRM. At the time of observation and shadowing, there was no way of generating HRM reporting to keep track of how many reports a particular physician received. Other physicians expressed concern about accuracy of the information as some documents such as progress notes, discharge notes may indicate that the document was dictated by a provider in a community health center rather than a hospital. Community health centers in the region have separate reporting system though HRM allows clinicians to receive reports from additional hospitals and independent health facilities throughout the province. Lack of a coherent system that integrates all institutions reporting into the EMR poses challenges to the use of EMR in the clinics.

4.3.4 Cost

The cost associated with joining the HRM program was indicated as an issue. There were no costs to using the HRM from OntarioMD’s end. However, Nightingale users incurred a cost of $21.75 per month, per provider, for using HRM interface in the EMR, and providers within a practice were not allowed to share a license. This raised new challenges related to technical support as it was not always clear where to address need for service requests because requests for support pertaining to EMR usage brought to the attention of an EMR vendor or provider may not address HRM regional integration issues, and vice versa.

Joining ClinicalConnect required an application process which involved signing a participation agreement either as a sole practitioner or as a healthcare organization. None of the observed physician identified cost as an issue with ClinicalConnect. Two, however, mentioned the need for regional integration entities responsible for implementation of ClinicalConnect to ensure better engagement with physicians to increase awareness.

Chapter 5

5 Findings: Quantitative research phase

5.1 Introduction

Findings from the quantitative research phases are presented below. The results include profile of participants, characteristics of EMR users and non-users, results of EMR use by vendor and for billing and scheduling. This chapter also covers then novel maturity model description and results of items constituting each stage of the maturity model, including items related to regional integration tools such as ClinicalConnect, Hospital Report Manager and Ontario Lab Information System. Results of reliability and validity tests and tests of association are also presented.

5.2 Descriptive and univariate analyses

5.2.1 Profile of participants : Questionnaire

In all, 58 primary care physicians completed the survey. Of that number, 50 indicated that they had and used an EMR. 43% of respondents identified as female and 57% identified as male. Majority of respondents were 45 years of age and older, suggesting older physicians constitute a high percentage of primary care and family medicine physicians practicing in southwestern Ontario. Of these, 28% were 65 years and older, 31% were between the ages of 55 and 64, 21% were between the ages of 45 and 54, and 10% were between the ages of 35 and 44 years of age. 20% of respondents were 35 years old or younger. Of the total respondents, 76% identified as family physicians while 24% identified as either general practitioners (17%) or other (7%), primarily clinic staff such as nurses or clinic managers who completed the surveys on behalf of physicians.

Most respondents (67.2%) had been working in primary care practice for more than twenty years, with 43.1% in primary care practice for longer than 30 years, 15.5% for between 26 and 30 years, and 8.6% between 21 and 25 years. Moreover, 20.7% of respondents worked in physician office – solo practice, 27.6% worked in physician office-group practice, and 34.5% worked in Family Health Teams. In addition to working in primary care, 6.9% of respondents had hospital privileges, 3.4% worked in Community Health Centre, and 1.7% indicated that they worked in Walk-in-Clinics. 5.2% of respondents selected the ‘other’ category, some of whom indicated working in academic research units and Family Health Organizations.

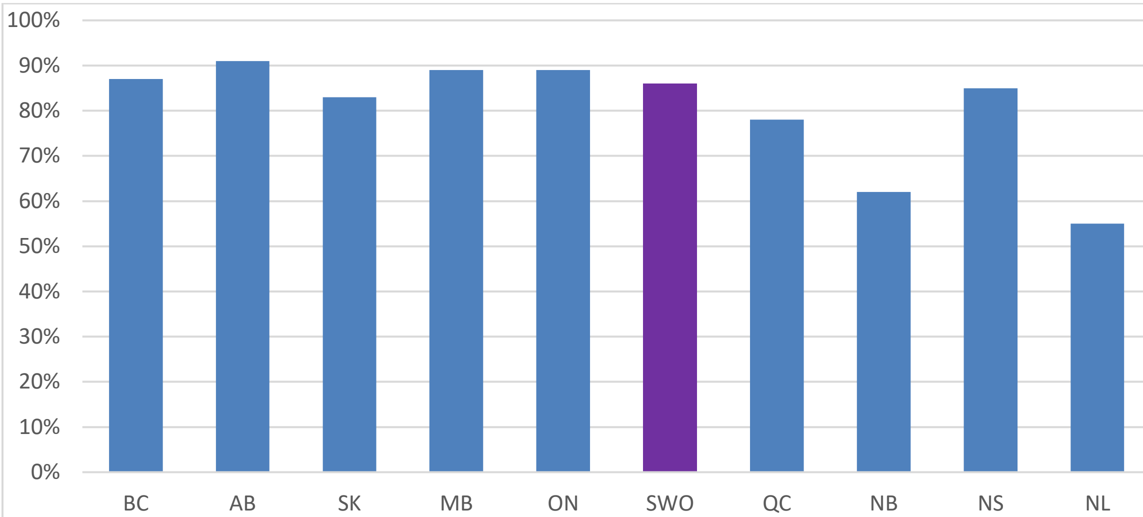

Figure 9. EMR use by province and SWO, 2017

Sources: CMA Workforce Survey, 2017; EMR Use and Impact in SWO Survey, 2017

86% of primary care physicians in South West Ontario (SWO) who responded to this thesis research questionnaire indicated that they used EMR. The Canadian Medical Association's workforce survey showed that in 2017, 89% of primary care physicians in the province of Ontario used EMR, a percentage higher than Southwest Ontario. In other Canadian provinces, Alberta (AB) had higher number of EMR users (91%, the highest percentage of EMR users by province), and Newfoundland and Labrador (NL) (55%, lowest percentage of EMR use by province) in 2017. The results further showed 87% of primary care physicians in British Columbia (BC), 83% in Saskatchewan (SK), 89% in Manitoba (MB), 89% in Ontario (ON), 78% in Quebec (QC), 62% in New Brunswick (NB), and 85% in Nova Scotia (NS) used an EMR.

Demographics	EMR Users, n= 50 (86%)	EMR Non-users, n=8 (14%)	Total, n=58 (100%)
Sex			
Male	26 (52%)	7 (87.5%)	33(57%)
Female	24 (48%)	1 (12.5)%	25 (43%)
Age Group			
Younger than 35 years	6 (12%)	0 (0%)	6 (10%)
35 to 44 years	6 (12%)	0 (0%)	6 (10%)
45 to 54 years	10 (20%)	2 (25%)	12 (21%)
55 to 64 years	16 (32%)	2 (25%)	18 (31%)
65 years and older	12 (24%)	4 (50%)	16 (28%)
Profession			
Family Physician	39 (78%)	5 (62.5%)	44 (76%)
General Practitioner	8 (16%)	2 (25%)	10 (17%)
Other	3 (6%)	1 (12.5%)	4 (7%)
Place of Work			
Physician Office - Solo Practice	8 (16%)	4 (50%)	12 (20.7%)
Physician Office - Group Practice	15 (30%)	1 (12.5%)	16 (27.6%)
Family Health Team	19 (38%)	1 (12.5%)	20 (34.5%)
Walk-in Clinic	0 (0%)	1 (12.5%)	1 (1.7%)
Community Health Centre	2 (4%)	0 (0%)	2 (3.4%)
Hospital	3 (6%)	1 (12.5%)	4 (6.9%)
Other	3 (6%)	0 (0%)	3 (5.2%)
How long have you had an EMR?			n=50
1 to 3 years	6 (12%)	n/a	6 (12%)
4 to 6 years	8 (16%)	n/a	8 (16%)
7 to 9 years	12 (24%)	n/a	12 (24%)
More than 10 years	24 (48%)	n/a	24 (48%)
How long have you been in primary health care practice?			
0 to 5 years	5 (10%)	0 (0%)	5 (8.6%)
6 to 10 years	5 (10%)	0 (0%)	5 (8.6%)
11 to 15 years	6 (12%)	0 (0%)	6 (10.4%)
16 to 20 years	2 (4 %)	1 (12.5%)	3 (5.2%)
21 to 25 years	4 (8%)	1 (12.5%)	5 (8.6%)
26 to 30 years	7 (14%)	2 (25%)	9 (15.5%)
More than 30 years	21(42%)	4 (50%)	25 (43.1%)

Table 11. Questionnaire respondent demographics

5.2.2 EMR users and non-users

Of the questionnaire respondents, 86% indicated that they used an EMR in their primary care practice. Among 14% who reported not using an EMR, top reasons expressed for lack of EMR use included reluctance to change brought about by EMR adoption and implementation, lack of clear indication of increase in efficiency, disruption to practice, cost of EMR adoption, the dauting process of converting from paper, lack of reliability, time consuming to learn, being more comfortable and faster with writing on or using paper, and nearing retirement. 46.9% of respondents who used EMR have had an EMR for more than ten years, 24.5% have had an EMR for between 7 and 9 years, 16.3% for 4 to 6 years and 12.2% for 1 to 3 years. None of the respondents reported having an EMR for less than a year.

Among non-EMR users, 87.5% identified as male and 12.5% as female. None of those who identified as non-EMR users were under the age of 45, 50% were 65 years of age or older, 25% were between the ages of 45 and 54 years, and 25% were between the ages of 55 and 64 years. Analysis by the number of years spent in primary health care practice revealed that 50% of non-EMR users have been in primary health care practice for longer than 30 years, 25% have been in practice from between 26 and 30 years, 12.5% have been in primary health care practice for 21 to 25 years, and 12.5% have been in practice for between 16 and 20 years.

52% of EMR users identified as male and 48% as female. Furthermore, 56 % were 55 years of age and over, 20% were between the ages of 45 and 54 years, 12 % were between the ages of 35 and 44 years, and 12% were younger than 35 years old. Analysis by number of years spent in primary health care practice revealed that 42% of EMR users have been in primary health care practice for longer than 30 years,14% have been in primary health care practice from between 26 and 30 years, 8% have been in primary health care practice for 21 to 25 years, 4% have been in practice from between 16 and 20 years, 12% for 11 to 15 years, 10 % for 6 to 10 years and 10% for 0 to 5 years. Among these respondents, 48% have had an EMR in their practice for longer than 10 years, 24% for 7 to 9 years, 16% for between 4 and 6 years, and 12% for 1 to 3 years.

5.2.3 EMR use by vendor

EMR vendors certified by Ontario MD operating in the region included Practice Solutions and Nightingale. With merger, the share of these two vendors added up to 68% as 52% of respondents reported using Practice Solutions and 16% reported using Nightingale. 18% of respondents reported using Accuro EMR, 4% used OSCAR EMR, 2% reported using ABEL Med EMR, while 8% reported using other EMRs. In Ontario, data sourced from Ontario MD indicated that the top two EMRs used by primary care physicians by vendor were Practice Solutions (35%) and Accuro MD (26%), Oscar EMR (12%), ABEL Med (4%) and other EMRs at 13%.

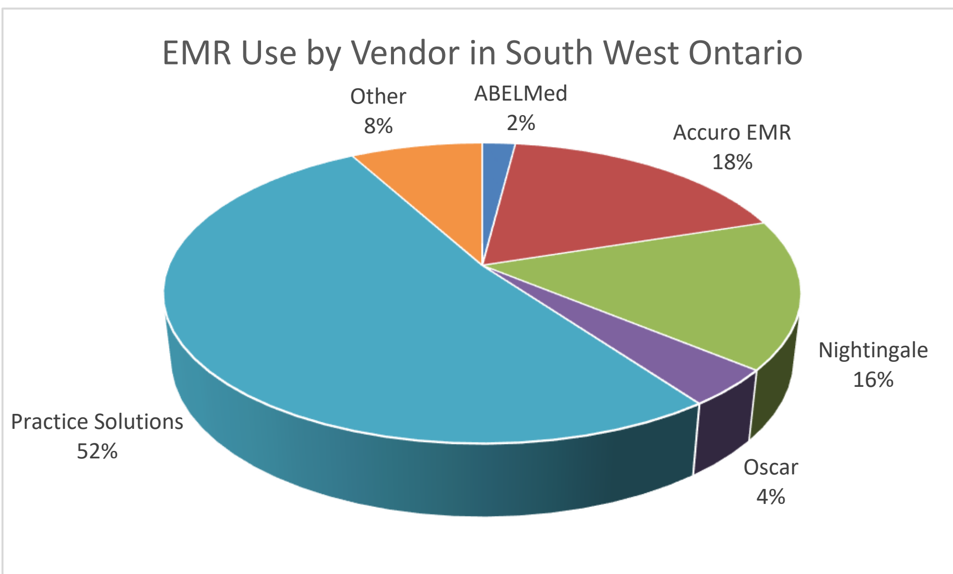

Figure 10. EMR use by vendor in South West Ontario

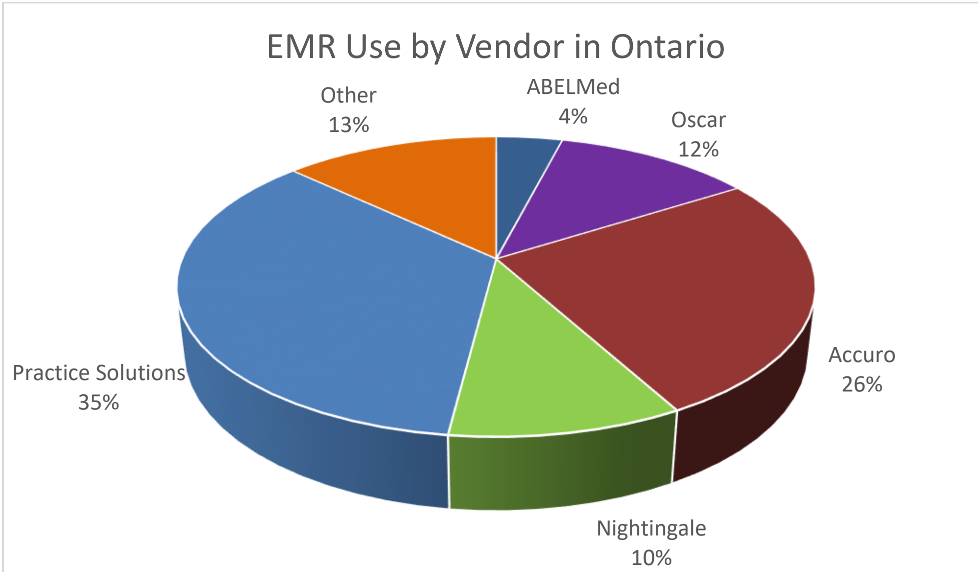

Figure 11. EMR use by vendor in Ontario

Source: OntarioMD EMR Vendor Market Share, Physician by EMR Vendor, 2018, www.ontariomd.ca

5.2.4 EMR funding, access, training, maintenance, and security

Among EMR users, 74% of respondents indicated that they received funding or financial incentives to adopt an EMR. Such funding was typically administered through provincial organizations responsible for assisting physicians with the adoption and enhanced use of technology to improve patient care. Despite the financial support received by some, more than a quarter of respondents (26%) indicated that they did not receive any funding or financial incentives to adopt an EMR. A large percentage of respondents (81%) reported not receiving any funding or financial incentives to maintain their EMR. Only 19% reported receiving funding or financial incentives to maintain their EMR.

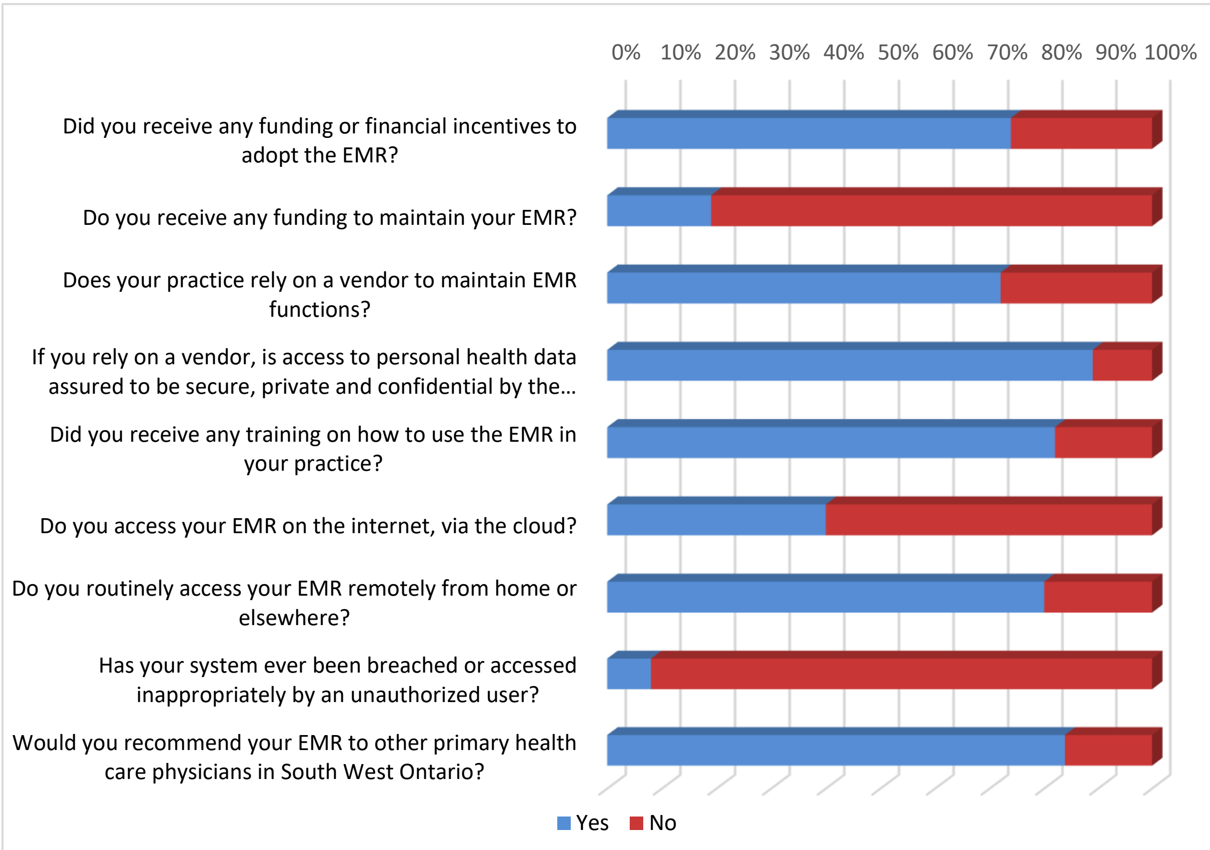

Figure 12. Responses to polar questions about EMR funding, access, training, maintenance, and security

Respondents were asked whether they relied on a vendor to maintain EMR functions, and if access to personal health data was assured to be secure, private and confidential by the vendor. 72% of respondents indicated that their practice relied on a vendor to maintain

EMR functions, while 28% answered “no” to that question. Among those who relied on a vendor to maintain EMR functions, 89% indicated that access to personal health data were assured to be secure, private, and confidential by the vendor. In terms of EMR training, 82 % of respondents answered “yes” to the question about receiving training on how to use the EMR in their practice, whole 18% indicated that they did not receive any training on EMR use. While a vast majority of respondents (80%) indicated routinely accessing their EMR remotely from home or elsewhere, only 40% accessed EMR via on the internet or via the cloud, 60% did not access the EMR via the internet or cloud. Surprisingly, 92% of respondents indicated that their system has never been breached or accessed inappropriately by unauthorized user. This may be due to lack of adequate systems and practices in place to detect and report EMR data breaches.

Overall, respondents were generally satisfied with EMR in their practices as 83% of respondents would recommend their current EMR to other primary care physicians in the region. As shown on Figure 13, 83.7% of respondents rated their EMR as excellent (18.4%), very good (36.7%), good (28.6%), or fair (10.2%). Only 6.1% of respondents rated their EMR as poor.

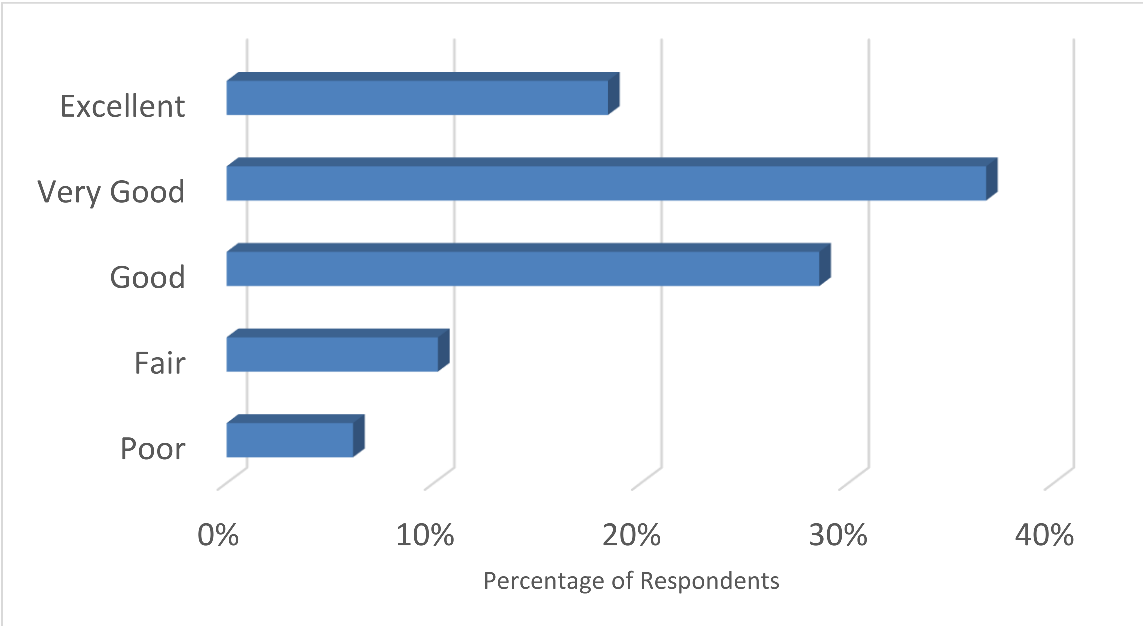

Figure 13. How respondents rated their EMR

5.2.5 Use of regional integration tools

Three regional integration tools examined in this research are the Ontario Laboratory Information System, Hospital Report Manager and ClinicalConnect. Findings from analysis of questionnaire items about the three regional integration tools are presented below.

5.2.5.1 Ontario Lab Information System

Item	Respondent N (%)				
	SD	D	N	A	SA
I receive lab test results through Ontario Lab Information System (OLIS) in my EMR.	3(6%)	2(4%)	1(2%)	19(38%)	24(48%)
My EMR provides tools to link a unique lab report to a patient encounter.	2(4%)	11(22%)	18(36%)	9(18%)	10(20%)

Table 12. Questionnaire responses about OLIS

The Ontario Laboratories Information System or OLIS as popularly known, allows authorized health care provides to access lab test orders and results from hospitals, community labs and public health labs. 86% of respondents either agreed (38%) or strongly agreed (48%) when asked whether they received lab test results through OLIS in the EMR. 10% of respondents either strongly disagreed (6%) or disagreed (4%) with the statement. Respondents were further asked whether the EMR provided tools to link unique lab reports to a patient encounter to which 38% strongly agreed (20%) or agreed (18%). 62% strongly disagreed, disagreed or remained neutral. The result suggests that while physicians may have access to patient lab orders and results through OLIS, the typical physician may not have those lab orders or tests results linked to unique patient encounter which may be due in part to lack of tools to link the EMR to lab reports at the level of the patient encounter, or lack of adequate knowledge or skill on the part of the physician to link unique lab reports to a patient encounter.

5.2.5.2 Hospital Report Manager

Item	Respondent N (%)				
	SD	**D**	**N**	**A**	**SA**
I routinely use Hospital Report Manager to retrieve details of patients' recent hospital visits.	10(20%)	11(22%)	9(18%)	6(12%)	14(28%)
Information retrieved from Hospital Report Manager is always timely, accurate and complete.	3(6%)	10(20%)	23(46%)	12(24%)	2(4%)

Table 13. Questionnaire responses about HRM

Hospital Report Manager (HRM) enables primary care physicians to securely receive patient reports electronically from participating hospital and specialty clinics. Physicians using an EMR certified by OntarioMD receive text-based discharge summaries and other patient medical records such as transcribed diagnostic imaging reports from sending facilities directly into the patient’s charts. 28% of respondents strongly agreed and 12% agreed with the statement “I routinely use Hospital Report Manager to retrieve details of patients’ recent hospital visits”. 18% of respondents neither agreed nor disagreed while

22% disagreed and 20% strongly disagreed with the statement. While 28% of respondents either strongly agreed (4%) or agreed (24%) with the statement about information retrieved from HRM always being timely, accurate and complete, most respondents either disagreed (20%), strongly disagreed (6%) or neither agreed nor disagreed (46%) with the statement.

5.2.5.3 ClinicalConnect

ClinicalConnect refers to cSWO Regional Clinical Viewer, a web-based portal that provides health service providers with real-time access to patients' electronic medical information from acute care hospitals, Home & Community Care Services, Regional Cancer Programs in South West Ontario, and a variety of provincial data repositories such as Ontario Laboratories Information System (OLIS) and Digital Health Drug Repository (DHDR). As shown in Figure 14, 74% of respondents indicated that they had ClinicalConnect while 26% indicated that they did not have ClinicalConnect.

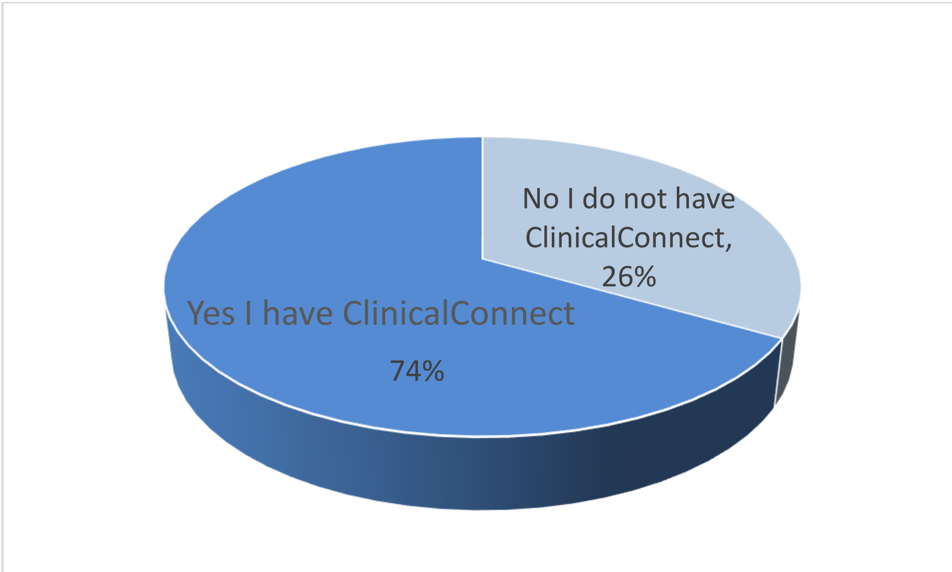

Figure 14. Responses to polar question: "Do you have ClinicalConnect?"

Analysis of routine use of ClinicalConnect among respondents who have ClinicalConnect showed that 42% either strongly agreed or agreed to routinely using ClinicalConnect to retrieve data, while only 30% agreed or strongly agreed that data accessed through ClinicalConnect were always timely, accurate and complete. 18% of respondents neither agreed nor disagreed with the statement about routine use of ClinicalConnect, and 40% either strongly disagreed (28%) or disagreed (12%). When asked whether data accessed through ClinicalConnect were always timely, accurate and complete, 6% or respondents strongly agreed and 24% of respondents agree, while 38% of respondents neither agreed nor disagreed with the statement. 22% of respondents either disagreed (14%) or strongly disagreed (8) with the statement that data accessed through ClinicalConnect were always timely, accurate and complete. 10% of respondents did not provide a response to the question.

These results suggest that despite having access to ClinicalConnect, several primary care physicians do not routinely use the tool to retrieve data. Respondents mentioned the kinds of data most frequently retrieved using ClincalConnect mainly comprising of hospital notes, patient notes, operating room reports, OLIS data and general lab reports. diagnostic imaging or radiology reports, consultant notes, specialist reports, dictations, reports missing from the EMR, pathology reports as well as pharmacy and dispensary information.

Item	**Respondent N (%)**				
	SD	**D**	**N**	**A**	**SA**
I routinely use ClinicalConnect to retrieve data.	6(12%)	14(28%)	9(18%)	12(24%)	9(18%)
Data accessed through ClinicalConnect are always timely, accurate and complete.	4(8%)	7(14%)	19(38%)	12(24%)	3(6%)

Table 14. Questionnaire responses about ClinicalConnect

Kinds of data most frequently retrieved from ClinicalConnect	**Number of mentions**
Hospital notes/patient reports/OR reports	20
Lab reports/OLIS data	12

Kinds of data most frequently retrieved from ClinicalConnect	Number of mentions
Radiology reports/diagnostic imaging/x-rays	9
Consultant/specialist reports	6
Pathology reports	1
Pharmacy dispensary information	1
Missing or remote reports	1
Diagnostic procedures	1
Dictations	1
None	6

Table 15. Kinds of data most frequently retrieved from ClinicalConnect by number of mentions.

5.3 Dimensions of regionally integrated EMR use

We developed a new, innovative maturity model based on six dimensions of regionally integrated EMR use to provide a framework for analyzing and describing key elements of operative EMR use within the context of regional integration of electronic health information resources. The model re-orients EMR maturity from an evolutionary improvement path which characterized prior maturity models, to actual use in primary health care. The model assumes that differences exist in maturity levels of EMR use and characterizes maturity levels based on actual EMR use reflective of physicians' and patients' needs. As information and technology evolve, questionnaire items could be modified to capture data about novel EMR features and use, since the primary determinant of maturity could vary over time. The model would further serve as a useful tool to help inform and guide software improvement processes for EMR integration.

5.3.1 Maturity level descriptions

Descriptions of six stages of the model are presented below.

Stage 6 broadly comprises of questionnaire items describing patient and community resource linkages which represents areas of very poor integration based on responses of questionnaire respondents. Stage 5 broadly comprises of questionnaire items describing performance and quality improvement. Mid-range items assigned to stage 4 of the maturity model indicate moderate regional integration or areas of moderate EMR use. This category broadly comprises of questionnaire items describing regional and provincial EMR linkages. Stage 3 items indicate moderate regional integration and areas of moderate EMR use, based on questionnaire responses. This category broadly comprises of questionnaire items describing practice improvement. Items assigned to stage 2 of the maturity model indicate areas of high EMR use. This category broadly comprises of questionnaire items describing EMR use which is more advanced than basic use. Stage 1 items indicate areas of very high EMR use based on questionnaire responses. This category broadly comprises of questionnaire items describing the most basic, routine, daily EMR use. The novel EMR use maturity model is presented below.

Maturity Level	Maturity Level Title						
Stage 6						Patient and Community Resource Linkages	
Stage 5					Performance and Quality Improvement		
Stage 4				Regional and Provincial Linkages			
Stage 3			Practice Improvement				
Stage 2		Basic Use Plus					
Stage 1	Basic Use						

Figure 15. Novel Regionally Integrated EMR Use Maturity Model

Results of EMR use questionnaire items that formed the basis of the model are presented as follows.

A vast majority of respondents (92%) use the EMR for billing and scheduling with 74% strongly agreeing and 18% agreeing to the statement on EMR use for billing and scheduling. Only 8% either strongly disagreed (6%) or disagreed (2%) with the statement. Respondents generally agreed with the statement that the EMR provides tools to record current patient problem and keep a continuous patient profile or CPP. 60% strongly agreed and 38% agreed with the statement. Only 2% chose neither agree nor disagree, no respondent disagreed or strongly disagreed. Most physicians use EMR to prescribe medications and generally agreed with the statement on EMR use for prescribing medications. 78% strongly agreed while 16% agreed with the statement. Only 6% chose either strongly disagree (2%) or disagree (4%).

Stage 1 – Basic Use					
Item	Respondent N (%)				
	SD	D	N	A	SA
I use my EMR for billing and scheduling	3(6%)	1(2%)	0(0%)	9(18%)	37(74%)
My EMR provides tools to record the current problem and keep a continuous patient profile (CPP)	0(0%)	0(0%)	1(2%)	19(38%)	30(60%)
I prescribe medications using the EMR in my practice.	1(2%)	2(4%)	0(0%)	8(16%)	39(78%)
I record and retrieve patient allergy information using my EMR	1(2%)	0(0%)	0(0%)	13(26%)	36(72%)
I record and retrieve patient immunization information using my EMR	1(2%)	0(0%)	0(0%)	12(24%)	37(74%)
I keep a medication list of a patient's current and past drugs using the EMR in my practice.	1(2%)	0(0%)	0(0%)	12(24%)	37(74%)

Table 16. Stage 1 Basic Use Items and Responses

Majority of respondents (98%) record and retrieve patient allergy information using the EMR with 72% strongly agreeing and 26% agreeing to the statement on recording and retrieving patient allergy information. Only 2% strongly disagreed with the statement. Likewise, respondents generally agreed with the statement on EMR use to record and retrieve patient immunization information. 74% strongly agreed and 24% agreed with the statement, only 2% strongly disagreed. Most physicians use EMR to keep medication lists of patients' current and past drugs, as such, they generally agreed with the statement on EMR use for keeping medication lists. 74% strongly agreed while 24% agreed with the statement. Only 2% chose strongly to disagree.

Stage 2 – Basic Use Plus					
Item	Respondent N (%)				
	SD	D	N	A	SA
My EMR provides tools to collect, store and update patient socio-economic information.	0(0%)	5(10%)	4(8%)	17(34%)	24(48%)
I receive lab test results through Ontario Lab Information System (OLIS) in my EMR.	3(6%)	2(4%)	1(2%)	19(38%)	24(48%)
I can easily generate a list of all laboratory results for an individual patient in my practice.	3(6%)	3(6%)	1(2%)	14(28%)	29(58%)
My EMR provides alerts (e.g. for drug interactions, allergies, severe reactions, abnormal tests results).	1(2%)	1(2%)	2(4%)	18(36%)	28(56%)
My EMR provides features to collect, store and update patient family history information.	0(0%)	3(6%)	0(0%)	19(38%)	28(56%)

Table 17. Stage 2 Basic Use Plus Responses

Several respondents agreed with the statement that the EMR in their practices provides tools to collect, store and update patient socio-economic information. This is partly due to the presence of socio-economic information in the CPP or patient profile in the EMR. 48% strongly agreed while 34% agreed with the statement. 18% of respondent either disagreed (10%) with the statement or remained neutral (8%). Similarly, a high percentage of respondents (88%) either agreed or strongly that they received lab test results through Ontario Lab Information System (OLIS), and 86% agreed or strongly agreed that they can easily generate a list of all lab test results for an individual patient in their practice. Only 10 to 12 percent of respondents disagreed with the statements. 56% strongly agreed and 36% agreed that their EMR provides alerts for drug interactions, allergies, severe reactions and abnormal test results, while a similarly large percentage strongly agreed (56%) or agreed (38%) agreed that the EMR provides features to collect, store or update patient family information.

Stage 3 – Practice Improvement					
Item	**Respondent N (%)**				
	SD	**D**	**N**	**A**	**SA**
I can use my EMR to generate a list of patients with multiple chronic conditions along with their prescriptions and lab test results in a given period of time.	3(6%)	6(12%)	17(34%)	11(22%)	13(26%)
I can easily generate a list of all patients taking a particular medication in my practice.	3(6%)	8(16%)	12(24%)	9(18%)	18(36%)
I can generate a clinical summary for each visit to give to a patient using my EMR.	7(14%)	5(10%)	5(10%)	14(28%)	19(38%)
I feel comfortable answering patients' questions while using the EMR.	3(6%)	8(16%)	6(12%)	21(42%)	12(24%)
I can use the EMR to determine how many of my patients receive recommended preventive care.	3(6%)	8(16%)	8(16%)	15(30%)	16(32%)
I can easily generate a list of patients by diagnosis using my EMR.	2(4%)	6(12%)	10(20%)	16(32%)	16(32%)
My EMR incorporates tools such as tables or graphs to track and support patient care over time including duration of condition, changes in severity and related time series or trend information.	2(4%)	4(8%)	9(18%)	19(38%)	16(32%)
My practice has an individual or group responsible for ensuring quality, security, and privacy of health information in the practice.	4(8%)	4(8%)	4(8%)	23(46%)	15(30%)
My EMR provides reminders (e.g. for preventative screening, immunizations, follow-up appointments).	1(2%)	5(10%)	8(16%)	16(32%)	20(40%)

Table 18. Stage 3 Practice Improvement Responses

On the question of using the EMR to generate a list of patients with multiple chronic conditions along with their prescriptions and lab test results in a given period, 26% of respondents strongly agreed, 22% agreed while 34% neither agreed nor disagreed. 18%

of respondents do not use the EMR to generate lists of patients with multiple chronic conditions along with prescriptions and lab test results in a given period.

Similarly, 36% strongly agreed and 18% agreed with the statement that they can easily generate a list of all patients taking a particular medication. 24% neither agreed nor disagreed with the statement, while 22% either disagreed or strongly disagreed. Several respondents (66%) agreed or strongly agreed that they could generate a clinical summary for each visit to give to a patient using the EMR while 34% disagreed, strongly disagreed or remained neutral to the statement. This result could be indicative of the fact that the EMR includes such features that allowed physicians to generate clinical summaries and not necessarily that physicians give their patients clinical summaries during or after visiting the clinic. Although several physicians (66%) reported feeling comfortable answering patient questions while using the EMR, not every physician feels comfortable doing so as 34% of respondents disagreed, strongly disagreed or remained neutral on the question.

Despite numerous physicians (62%) agreeing or strongly agreeing with the statement on use of EMR to determine how many patients received recommended preventive care, a substantial percentage (38%) of respondents disagreed, strongly disagreed or remained neutral on the question. Similarly, 64% agreed or strongly agreed that they could easily generate a list of patients by diagnosis using the EMR, while 36% strongly disagreed,

disagreed or neither agreed nor disagreed with the statement. 32% of respondents strongly agreed and 38% agreed that the EMR in their practice incorporates tools such as tables or graphs to track and support patient care over time including duration of condition, changes in severity and related time series trend information. 18% of respondents neither agreed nor disagreed with the statement, while 12% disagreed (8%) or strongly disagreed (4%).

While 76% of respondents strongly agreed (30%) or agreed (46%) to having an individual or group in the practice responsible for ensuring quality, security and privacy of health information in the practice, 16% strongly disagreed (8%) or agreed (8%) to the statement, while 8% neither agreed nor disagreed. Regarding EMR providing reminders for preventative screening, immunizations, and follow-up appointments, 72% strongly agreed (40%) or agreed (32%) while 16% neither agreed nor disagreed. 12% of respondents disagreed (10%) or strongly disagreed (2%).

Stage 4 – Regional and Provincial Linkages					
Item	**Respondent N (%)**				
	SD	**D**	**N**	**A**	**SA**
I use my EMR to reconcile differences between patient reported information and information existing in EHR, OLIS, HRM and other sources.	7(14%)	12(24%)	11(22%)	14(28%)	6(12%)
I routinely use Hospital Report Manager to retrieve details of patients' recent hospital visits.	10(20%)	11(22%)	9(18%)	7(14%)	13(26%)
Data accessed through ClinicalConnect is always timely, accurate and complete.	4(8%)	7(14%)	19(38%)	12(24%)	3(6%)
I routinely use ClinicalConnect to retrieve data.	6(12%)	15(30%)	8(16%)	14(24%)	9(18%)

Stage 4 – Regional and Provincial Linkages					
Item	Respondent N (%)				
	SD	D	N	A	SA
My EMR provides tools to link a unique lab report to a patient encounter.	2(4%)	11(22%)	13(36%)	9(18%)	10(20%)
My patients can view their lab test results securely online.	7(14%)	6(12%)	6(12%)	26(52%)	5(10%)
My EMR allows electronic formation of clinical teams with defined roles and responsibilities.	4(8%)	8(16%)	17(34%)	12(24%)	9(18%)
My EMR supports data collection that meet regional, provincial, and national health information standards (e.g. coding standards, terminology standards, data quality standards).	3(6%)	8(16%)	15(30%)	12(24%)	12(24%)

Table 19. Stage 4 Regional and Provincial Linkages Responses

Most respondents do not use EMR to reconcile differences between patient reported information and information existing in integration tools such as OLIS, HRM or other electronic health records. Only 12% strongly agreed, 28% agreed with the statement on reconciling patient reported information, 60% of respondents chose neither agree nor disagree (22%), disagree (24%) or strongly disagree (14%). Similarly, only 40% of respondents either agreed (14%) or strongly agreed (26%) with the statement on routine use of HRM to retrieve details of patients' recent hospital visits. Among the other 60% of respondents to this statement, 18% chose 'neither agree nor disagree', 22% disagreed and 20% strongly disagreed.

74% of respondents indicated that they had the regional integration tool ClinicalConnect. However, only 42% routinely use ClinicalConnect to retrieve data. 18% strongly agreed, 26% agreed with the statement. Of the remaining 58%, 16% chose to neither agree nor disagree with the statement while 30% disagreed and 12% strongly disagreed. Still on ClinicalConnect, respondents were asked whether data accessed through the regional integration tool were always timely, accurate, and complete. Only 8% of respondents strongly agreed while 26% agreed with the statement, 66% chose either ‘strongly disagree’ (10%) or disagree (16%) while 40% chose to neither agree nor disagree with the statement.

The results suggest several physicians experience challenges related to linking information from labs to patient encounter in the EMR. Only 38% of respondents either strongly agreed (20%) or agreed (18%) that the EMR in their practice provides tools to link unique lab report to a patient encounter. 36% neither agreed nor disagreed with the statement while 28% either disagreed (22%) or strongly disagreed (4%) with the statement. By contrast, most physicians agreed (52%) or strongly agreed (10%) that their patients can view lab test results securely online. Of the remaining 38%, 12% neither agreed nor disagreed with the statement, another 12% disagreed while 14% strongly disagreed.

On electronic formation of clinical teams via EMR, 18% of respondents strongly agreed and 24% agreed with the statement that EMR in their practice allowed for electronic formation of clinical teams with defined roles and responsibilities. While 34% neither agreed nor disagreed with the statement, 24% either disagreed (16%) or strongly disagreed (8%). 30% of respondents neither agreed nor disagreed, and 48% of strongly agreed (24%) or agreed (24%) that their EMR supports data collection that meets regional, provincial and national health information standards such as coding standards, terminology standards and data quality standards. Of the remaining 22%, 16% disagreed and 6% strongly disagreed with the statement.

Stage 5 – Performance and Quality Improvement					
Item	**Respondent N (%)**				
	SD	**D**	**N**	**A**	**SA**
I can enter or sync patient data from other devices such as mobile devices to my EMR.	12(24%)	15(30%)	13(26%)	6(12%)	4(8%)
When I update patient information in the EMR, I usually allow patients to review, correct and update their health information.	8(16%)	18(36%)	10(20%)	11(22%)	3(6%)
My EMR provides tools to support coordination of patient care needs related to ambulatory, nursing home, emergency, and hospital care.	9(18%)	18(36%)	14(28%)	5(10%)	4(8%)
My practice routinely receives information on how our clinical performance compares to other practices.	7(14%)	16(32%)	15(30%)	7(14%)	5(10%)
My practice can review our clinical performance against regional, provincial and national targets.	5(10%)	15(30%)	15(30%)	11(22%)	4(8%)
My EMR incorporates educational materials, decision aids or patient value assessment tools to support patient-clinician shared decision making.	10(20%)	10(20%)	7(14%)	20(40%)	3(6%)
My EMR provides care guidelines, care paths and other decision support tools.	7(14%)	12(24%)	15(30%)	9(18%)	7(14%)
Information retrieved from Hospital Report Manager is always timely, accurate and complete.	3(6%)	10(20%)	23(46%)	11(22%)	2(4%)

Table 20. Stage 5 Performance and Quality Improvement Responses

Most physicians can’t enter or sync patient data from devices such as mobile devices to their EMR as evidenced in responses to the statement which showed only 8% of respondents in strong agreement and 12% in agreement. A vast majority (80%) of respondents strongly disagreed (24%), disagreed (30%) or neither agreed nor disagreed (26%) with the statement. Results suggest that most physicians usually do not allow patients to review, correct and update health information when updates are made to patients’ information in the EMR as only 6% of respondents strongly agreed and 22% agreed with the statement. Of the 72% remaining, 20% neither agreed nor disagreed, 36% disagreed and 16% strongly disagreed with the statement. Fewer than a fifth of physicians thought the EMR in use in their practices provided tools to support coordination of patient are needs related to ambulatory, nursing home, emergency and hospital care, only 8% of respondents strongly agreed and 10% agreed to the statement, 28% neither agreed nor disagreed, 36% disagreed and 18% strongly disagreed.

On the question of clinical performance. 24% of respondents agreed (14%) or strongly agreed (10%) with the statement about routinely receiving information on how clinical performance compared with other practices, 30% neither agreed nor disagreed, 30% disagreed and 14% strongly disagreed. On a similar question, only 30% of respondents either strongly agreed (8%) or agreed (22%) that they can review their practice’s clinical performance against regional, provincial and national targets.40% either strongly disagreed (10%) or disagreed (30%) while 30% neither agreed nor disagreed with the statement.

Stage 6 – Patient and Community Resource Linkages					
Item	**Respondent percentage (%)**				
	SD	**D**	**N**	**A**	**SA**
My practice supports enhanced asynchronous patient care via email, texting, video-conferencing, and other bidirectional communication mechanisms.	22(44%)	20(40%)	6(12%)	2(4%)	0(0%)
My EMR supports patient online requests for refills of prescription.	21(42%)	22(44%)	6(12%)	1(2%)	0(0%)
My patients can enter, retrieve, or update information directly through patient portals, open notes, or shared information spaces during a visit.	25(50%)	13(26%)	7(14%)	4(8%)	1(2%)
My EMR supports patients to electronically request or schedule appointments.	23(46%)	17(34%)	7(14%)	3(6%)	0(0%)
My EMR supports patients' requests for referrals online.	21(42%)	15(30%)	10(20%)	3(6%)	1(2%)
My EMR allows me to securely track and coordinate ancillary services such as community services, transportation, interpretation, social services, case management and financial assistance tailored to individual patients.	16(32%)	20(40%)	13(26%)	1(2%)	0(0%)
My EMR provides tools to link and exchange information with public and population health resources and programs.	15(30%)	23(46%)	8(16%)	4(8%)	0(0%)
My EMR provides tools to link and exchange information with mental health resources and programs.	15(30%)	18(36%)	11(22%)	4(8%)	2(4%)
My EMR provides tools to link and exchange information with community resources, programs and caregivers that may support primary health care patient needs.	13(26%)	19(38%)	13(26%)	4(8%)	1(2%)
I am able to import data from other EMR or EHR systems.	13(26%)	14(28%)	15(30%)	6(12%)	2(4%)

Stage 6 – Patient and Community Resource Linkages					
Item	Respondent percentage (%)				
	SD	D	N	A	SA
I can record and upload multimedia (audio, video, images) from a patient visit into my EMR in simple and intuitive formats.	14(28%)	18(36%)	4(8%)	11(22%)	3(6%)

Table 21. Stage 6 Patient and Community Resource Linkages Responses

Most physicians work in practices that do not support enhanced asynchronous patient care via email, texting, video-conferencing, and other bidirectional communication mechanisms as none of the respondents strongly agreed and only 4% agreed with the statement, while 84% either strongly disagreed (44%) or disagreed (40%), 12% neither agreed nor disagreed. For the most part, respondents strongly disagreed (42%) or disagreed (44%) that their EMR supports patient online requests for refills of prescription. None of the respondents strongly agreed with the statement, only 2% agreed while 12% neither agreed nor disagreed. Majority of respondents (76%) disagreed that patients can enter, retrieve or update information directly through patient portals, open notes or shared information spaces during a visit. Only 10% either agreed (8%) or strongly agreed (2%) with the statement while 50% strongly disagreed, 26% disagreed and 14% neither agreed nor disagreed. Similarly, respondents think EMRs in current use neither support patients to electronically request or schedule appointments nor support patients' requests for referrals online.46% strongly agreed, 34% agreed and 14% of respondents neither agreed nor disagreed with the statement on EMR support for patient appointment request or scheduling. Only 6% agreed while no respondent strongly agreed with the statement. Patients' requests for online referrals showed similar results as 42% strongly disagreed, 30% disagreed and 20% neither agreed nor disagreed with the statement. Only 6% of respondents agreed and 2% strongly agreed that their EMR supports patients' requests for referrals online.

Current EMRs do not allow users to securely track and coordinate ancillary services such as community services, transportation, interpretation, social services, case management and financial assistance tailored to individual patients. This is evidenced by 98% of respondents disagreeing or being neutral to the question. No respondent strongly agreed and only 2% agreed with the statement while 32% strongly disagreed, 40% disagreed and 26% neither agreed nor disagreed.

Results show current EMRs fare badly with regard to linking and exchanging information with public and population health resources and programs, mental health resources and programs, and with community resources, caregivers and programs that may support primary health care patient needs. 30% of respondents strongly disagreed, 46% disagreed, 16% neither agreed nor disagreed, and 8% agreed that their EMRs provide tools to link and exchange information with public and population health resources and programs. 30% of respondents strongly disagreed, 36% disagreed, 22% neither agreed nor disagreed, 8% agreed and 4% strongly agreed that their EMRs provide tools to link and exchange information with mental health resources and programs. Average weighted score of 2.01 places this item in Stage 6 of the maturity model. 26% of respondents strongly disagreed, 38% disagreed, 26% neither agreed nor disagreed, 8% agreed and 2% strongly agreed that their EMRs provide tools to link and exchange information with community resources, programs and caregivers that may support primary health care patient needs.

5.3.2 Result of tests of differences

The aim of tests was twofold. First, to explore and investigate differences between stages of the maturity model and key characteristics of respondents. Second, to explore, investigate and attempt to provide answers to the research question: “What are the factors influencing the use of regionally integrated EMR?”

To explore these differences, we present a study model for analyzing the relationship between the stages of the maturity model and key characteristics of respondents. Although there could be other key factors that may influence a maturity stage, we chose our variables to keep the scope of this study within regionally integrated EMR and physicians’ points of view. In particular, we examined the effect of independent variables (sex, years in primary care practice, years of having EMR, location of practice and how physicians rate their EMR) on EMR maturity state.

Pre-defined maturity levels (Stage1 to Stage6 from the questionnaire which were already coded as a group of 5-point Likert score items), were treated as ordinal variables. Therefore, for a group of Likert-type questions per stage, the median of scores per observation was calculated. This resulted in six separate ordinal, Likert-type variables for Stage1 to Stage 6 which served as six separate outcomes for the current analysis. The summary statistics are provided in Table 22. These ordinal variables were considered as the outcomes of interest.

Stage 1	Freq.	Percent	Cum.	**Stage 2**	Freq.	Percent	Cum.
2	2	4.08	4.08	1	1	2.13	2.13
4	17	34.69	38.78	4	13	27.66	29.79
5	30	61.22	100	5	33	70.21	100
Total	49	100		Total	47	100	
Stage 3	Freq.	Percent	Cum.	**Stage 4**	Freq.	Percent	Cum.
1	2	4.26	4.26	1	2	4.35	4.35
2	5	10.64	14.89	2	16	34.78	39.13
3	10	21.28	36.17	3	19	41.3	80.43
4	14	29.79	65.96	4	6	13.04	93.48
5	16	34.04	100	5	3	6.52	100
Total	47	100		Total	46	100	
Stage 5	Freq.	Percent	Cum.	**Stage 6**	Freq.	Percent	Cum.
1	5	10.2	10.2	1	17	34.69	34.69
2	18	36.73	46.94	2	20	40.82	75.51
3	18	36.73	83.67	3	8	16.33	91.84
4	6	12.24	95.92	4	4	8.16	100
5	2	4.08	100	Total	46	100	
Total	46	100					

Table 22. Summary statistics of median Likert scale per stage

In this analysis, each new ordinal stage variable (Stage1 to Stage6) was considered as a separate outcome and their association analyzed with the following covariates:

1- Gender (Coded as Sex, the covariate label represents sex)

2- Age Group (Coded as Age-Group)

3- Years spent in primary health care practice (Coded as Years_PHC)

4- Years of having EMR in practice (Coded as EMRAE10)

5- How the physician rates EMR currently used in primary care practice (Coded as EMRAE20)

6- Location of Practice (Coded as Local Health Integration Network or LHIN)

Considering the small number of observations in the current research, it was of vital importance to avoid the multicollinearity among independent variables as much as possible. Multicollinearity refers to linear relation among two or more variables which may cause difficulty in reliability of estimates (Alin, 2010). Among all, variables which measure the length of time such as age (Age_Group), years in primary health care practice (Years_PHC) and years of having EMR in the practice (EMRAE10) were considered the best candidates. Results of the correlation analysis revealed that pair covariates of [EMRAE10, Years_PHC] and [Age_Group , Years_PHC] are of highly correlated nature with Spearman's rank correlation coefficient or rho and significance level of [Rho=0.4243,p=0.0024] and [Rho= 0.8391,p< 0.0001]. As Years_PHC follows the same direction as other two time-wise covariates and is highly correlated with both, decision was made to drop one of the variables from the analysis to avoid possible complications from multicollinearity. Two time-wise covariates were kept in the rest of the analysis to avoid loss of information. It should be noted that this collinearity test has been checked with ordinal regression and results agree closely with the current analysis.

As stated in chapter 3, null hypotheses examined the relationships between each of the five retained covariates with stages of the maturity model.

Kruskal Wallis test and ordinal logistic regression were deployed in order to assess the possible association of 5-point Likert-type outcomes for Stage1 to Stage6 of the maturity model with categorical covariates of sex (Sex), location of practice (LIHN), years of primary health care practice (Years_PHC), length of time physician has had an EMR (EMRAE10) and how physician rated EMR (EMRA20).

In two ways, the association of each ordinal Likert-type Stage variable (Stage1 to Stage6) and the independent covariates were assessed:

1- Based on unadjusted methods: The association between each outcome and independent covariate were analyzed separately through non-parametric analysis of variance using Kruskal-Wallis test.

2- By ordered logistic regression analysis.

Summary of findings

Detailed results including summary of each finding, regression models and data tables are provided in Appendix F.

The analyses were carried out on a total number of observations of 50 individuals. The results of both unadjusted and adjusted association analyses were in very close agreement to detect the following:

- EMRA20 covariate (i.e. How physicians rated EMR currently in use in their practice) was the most significant predictor of Stage 1 (Basic use stage) of the maturity model.

- EMRA20 covariate (i.e. How physicians rated EMR currently in use in their practice) was the most significant predictor of Stage 2 (Basic use plus stage) of the maturity model.

- EMRA20 covariate (i.e. How physicians rated EMR currently in use in their practice) was the most significant predictor of Stage 3 (Practice improvement stage)) of the maturity model.

- Location of practice (LHIN covariate) was the most significant predictor of Stage 4 (Regional and provincial linkages stage) of the maturity model.

- None of covariate were detected as significant predictors at 0.05% level of significance for Stage 5(Performance and quality improvement stage) & Stage 6 (Patient and community resource linkages) of the maturity model.

- Sex appeared not to play a significant role as a predictor for outcome variables.

5.4 « Chapter summary »

Findings from the quantitative research phases were presented. The results presented included profile of participants, characteristics of EMR users and non-users, results of EMR use by vendor and for billing and scheduling. This chapter also covered the novel maturity model description and results of items constituting each stage of the maturity model, including items related to regional integration tools such as ClinicalConnect, Hospital Report Manager and Ontario Lab Information System. Results of reliability and validity tests and tests of association are also presented. The next chapter is a presentation of findings from the qualitative research phase.

Chapter 6

6 Findings: Participant interviews component

6.1 Introduction

To gain deeper insights into key issues related to physician use of EMR within the context of regional integration in South West Ontario, semi-structured interviews were conducted. In the previous chapters, the processes of data collection and analyses were described. This chapter continues with the presentation of findings as I present the results from those participant interviews, starting with profile of participants. The quotations presented in this section illustrate only some of the many ways in which primary health care physicians experience and express their use of and impact of the EMR. The results presented reflect different perspectives in their experience of using a regionally integrated EMR – seeing information as an essential component of patient care and the patient encounter, seeing technology as an enabler of better care in improving doctor-patient communication, and in experiencing some of the frustrations of a not-yet seamlessly connected electronic system. Participants described, among other things, how they experienced the use and impact of regional electronic information integration tools, their experience with transitioning from one EMR system to another, how they managed patients' expectations, working with the EMR within different practice contexts, meeting information needs and so on.

6.1.1 Profile of participants: Interview phase

Alias	Sex	Approximate number of years of primary health care experience	Approximate number of years of EMR experience in primary health care practice	Length of interview (minutes)
PSWO1	M	7	7	35
PSWO2	M	28	12	45
PSWO3	M	24	13	115
PSWO4	M	33	15	43
PSWO5	F	3	3	35
PSWO6	M	40	20	69
PSWO7	M	46	15	63
PSWO8	F	10	10	57
PSWO9	M	13	9	43
PSWO10	M	15	8	27
PSWO11	F	6	6	41
PSWO12	F	45	15	59
PSWO13	M	5	5	47
PSWO14	F	3	2	66
PSWO15	M	41	14	42
PSWO16	F	5	5	38
PSWO17	M	7	6	63
PSWO18	F	30	10	48
PSWO19	F	31	6	65
PSWO20	M	7	5	58
PSWO21	F	3.5	3	28
PSWO22	M	8	7	42
PSWO23	F	8	5	25
PSWO24	M	6	6	64

Table 23. Profile of participants (semi-structured interview)

6.2 Emergent themes

Thirteen main themes emerged from analysis of responses of participants in the qualitative component of this research. Seven themes emerged from categories and subcategories coded as influencing respondent perception of use. These were EMR offering, EMR content, integration tool, patient characteristic, physician characteristic, practice type, and information attributes related to data and information quality. In addition to emergent theme about using integration tools, six themes emerged from categories and subcategories coded as influencing the perception of integration. These were coded as working through change, managing patient expectations, engaging regional entities, identifying support sources, meeting information needs, comparing practice contexts. Below, emergent themes influencing the perception of EMR integration are presented first, followed by emergent themes influencing perception of EMR use.

6.2.1 Defining emergent themes

Several core categories emerged from analyzing the data collected in this thesis. In this section, I provide brief descriptions of the main themes. The first six themes describe influences on physicians’ perception of EMR integration, the latter seven themes categorize influences on physicians’ perception of EMR use.

Working through change

The experience of EMR use is shaped by change not only in terms of technology such as EMR tools and offerings, but also by changes to physician workflow. This core category emerged as a theme to identify responses indicating that even though participants may have previously used EMR or may have been practicing in primary care for a long time, the experience of EMR transitioning imposes need for adjustments to how they work. This category also codes responses indicating or implying the use both paper-based and electronic medical record systems.

Managing patient expectations

This theme identified physicians’ attitudes towards patients’ access to their own health information. Attitude here is used to mean the manner in which physicians think or feel about patient information. While some primary health care physicians see themselves as custodians of patient health information, others feel patients should be at the center of integration, and in order to deliver best patient care, it is important to view information about patients in the EMR and other sources as an extension of the patients.

Engaging regional entities

This theme captures physicians’ experiences of using regional integration tools such as ClinicalConnect. It was mainly used to capture description of physician experiences of engaging with organizations implementing integration tools, as well as nuances of working in primary care *vis-a-vis* connecting with hospitals, pharmacies and walk-in-clinics.

Identifying support sources

One of the challenges expressed by participants in using regionally integrated EMR was the question of support, which could be related to cost of acquiring and maintaining an EMR, especially for new physicians who may not have received funding to adopt an EMR. It could also be related to support for everyday use including technical support from EMR vendors, support received through programs by professional organizations such as OntarioMD, support related to training, as well as support or lack thereof at the practice level. This theme was used to identify such instances.

Meeting information needs

Although this was not always explicitly stated in the interviews, certain participant responses indicated the value placed on information quality in meeting patient care needs. While some respondents described activities and perceptions related to dimensions of information quality such as accuracy of information, others identified areas in which their primary care practices needed better information, and ways of making integrated EMR data meaningful. This theme was used to capture such notions that apply both to integration and use.

Comparing practice contexts

The experience of integrated EMR use varies by practice context. Primary health care physicians with hospital privileges described more advanced integrated EMR use compared to primary care physicians who only worked in the community, without hospital privileges. Variations also exist in EMR use among urban and rural practices. Some physicians compared the condition of EMR integration in Ontario with American integrated managed care consortium, Kaiser Permanente, indicating, among other things, comparable population sizes (about nine million people each), and use of single, integrated medical record system. This theme was applied when such statements or notions were expressed by participants or interpreted by the researcher.

Emergent themes, categories and sources coded as influencing perception of integration are presented in Table 24.

Emergent theme	Category
Working through change	Experiencing EMR transitioning Transitioning as practice changing moment Working with hybrid medical record system
Using integration tools	ClincalConnect Hospital Report Manager Ontario Lab Information System
Managing patient expectations	Patients accessing health information

	Putting patients at centre of integration Viewing information as extension of the patient
Engaging regional entities	Connecting South West Ontario Community Care Access Centres, Ontario Telemedicine Network, Connecting with hospitals, pharmacies, walk-in clinics
Identifying support sources	Developing partnerships for EMR use Addressing cost of maintaining EMR Describing experience with EMR training
Meeting information needs	Making EMR data meaningful Ensuring accuracy of information Identifying need for better information
Comparing practice contexts	Comparing with hospital privileges Comparing rural-urban primary health care practices Comparing with Kaiser Permanente

Table 24. Emergent themes and categories coded as influencing perception of EMR integration

The following emergent themes identified influences on physicians' perception of EMR use.

EMR offering

Available EMR offerings have some influence on how physicians use EMR. The EMR offering theme identified physicians' ideas of an ideal EMR, how physicians decided on which EMR to use, and their experiences using specific EMR offerings available in their practices. The concept of *idealizing* emerged from analysis of participant responses to questions about ideal EMR, the *deciding* category emerged in response to inquiries about how they decided to adopt or use an EMR, and the *specifying* category on specific EMRs such as Nightingale, Accuro, OSCAR or Telus Practice Solutions.

EMR content

This theme was used to identify participants' responses that reflect physicians' statements about need for information to be available in usable formats. The idea of *customizing* was highlighted in the interviews referring to ability to modify, adapt or tailor EMR content to user needs. It also identified statements related to reconciling information from different sources. The category *relishing* was used to identify statements that reflect easy access and ease of use as incentives for using EMR, while the category *loathing* identified responses about drawbacks of EMR content including ubiquity of legacy functionality.

Integration tool

ClinicalConnect, Hospital Report Manager and Ontario Lab Information System were identified as three common regional integration tools in south west Ontario. This category identified responses indicating the use and impact of these tools. Other integration tools identified by respondents were also categorized under this theme.

Practice context

Statements and notions about uniqueness of primary health care, solo practices, group practices, and family health teams were identified under this theme. The theme also identified statements about support for workflow and inevitability of electronic medical record systems to delivery of patient care in various primary care practice types (i.e. “not going back to paper”).

Patient characteristic

Several participants described their patient population in the context of EMR use. Given that patients were not directly interviewed, such descriptions included views about physicians serving as proxy for patients and channeling the art of medicine. Generally, patient portals aren’t fully integrated and, as a result, benefits of integrated EMR aren’t fully realized. Statements indicating such notions were captured under this theme.

Physician characteristic

This theme was used to identify participants’ responses that reflect physician characteristics in relation to EMR use. Most participants exhibited characteristics typical of regular EMR users, while others self-described as superusers. Superusers typically work within primary health care teams, often served as liaison between developers and clinical teams, acted as peer leaders for EMR use, may be more proficient in EMR use than others, and provide technical support to other clinicians. The physician-developer combines the roles of primary care physician and builder or creator of EMR software and applications. In some instances, the physician writes software programs or scripts to improve efficiency of EMR use. The luddite is averse to EMR and to changes to accustomed ways of doing clinical work that may accompany EMR use.

Table 25 shows emergent themes and categories coded as influencing perception of EMR use.

Emergent theme	Category
EMR offering	Idealizing Deciding Specifying
EMR content	Customizing, reconciling, standardizing, trending Loathing of legacy functionality Relishing access and ease of use
Integration tool	ClinicalConnect Hospital Report Manager Ontario Lab Information System Other integration tools
Information attribute (Data and information quality)	Accuracy (Garbage in, garbage out) Timeliness Comparability and completeness
Practice type	Differentiating primary care Solo practice, group practice, family health team Supporting workflow Moving with the time

Emergent theme	Category
Patient characteristic	Describing (Patient Population) Channeling the art of medicine (Physician as proxy) Integrating (Patients and patient portals)
Physician characteristic	Regular user Superuser Physician-developer Luddite

Table 25. Emergent themes and categories coded as influencing perception of EMR use

6.3 Emergent themes influencing perception of integration

Below is a presentation of the six themes based on results of the interviews. Each of these main themes is composed of at least three subcategories from analysis of the participant interviews.

6.3.1 Working through change

Participants described their experience of using EMR during periods of transition. The experience of EMR use is often shaped by changes to technology, EMR vendor changes, or changes within a practice, as users shift from paper-based records to electronic medical records, or from one electronic medical record to another. Results indicate that change isn't only about technology such as EMR tools and offerings. Change is also about modifications to physician or clinical workflow. This core category emerged as a theme to identify responses indicating that even though participants may have previously used EMR or may have been practicing in primary care for a long time, the experience of EMR transitioning and migration imposes adjustments to how they worked. This category also captured responses indicating or implying the use both paper-based and electronic medical record systems.

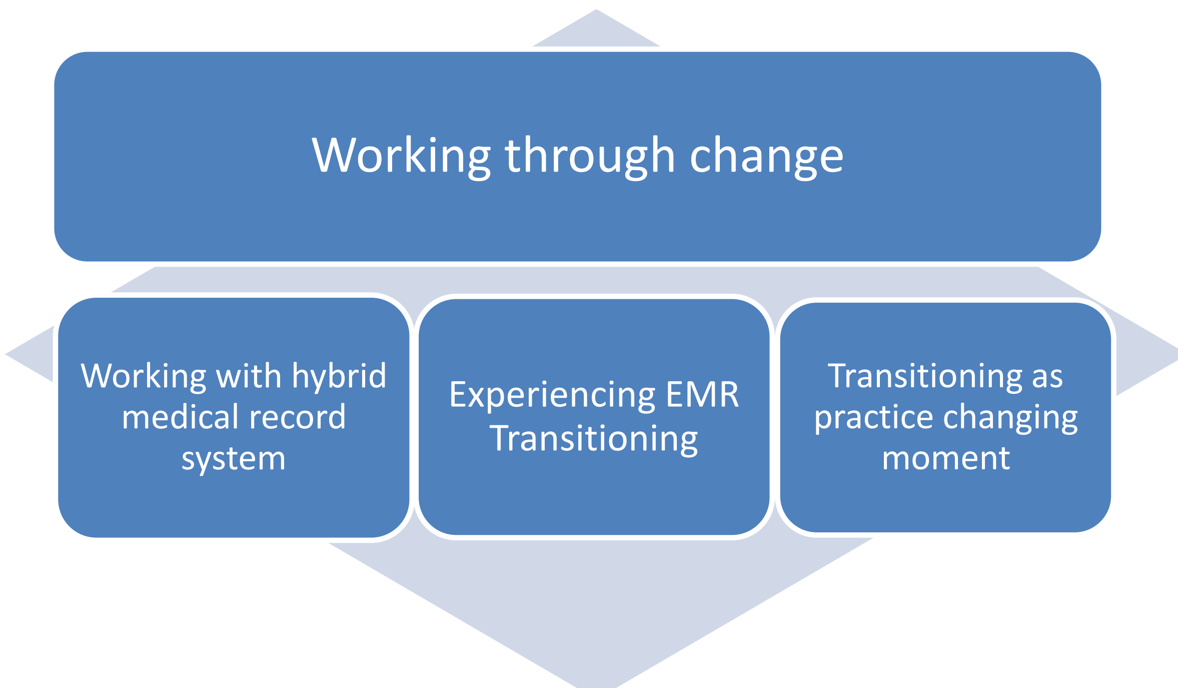

Figure 16. Emergent theme 'working through change' and categories

6.3.1.1 Working with hybrid medical record system

Having to transition EMR sometimes lead physicians back to using paper-based medical records or some form of a hybrid, paper-electronic system. However, not all hybrid systems involve paper-based records as some participants described instances where electronic documentation involved only dictation. According to participants, the rationale for using hybrid systems was four-fold. First, to maintain access to patient records or x-rays that existed before EMR was instituted. Second, there are several primary health care transactions that still rely heavily on use of paper. Third, primary care practices often have physicians who are averse to using EMR. Fourth, to have paper records for reference or as back-up to electronic records in case of system failure. However, some respondents perceived the utility of keeping patient records diminished after the legal requirement of 10 years instituted by the Colleges of Physicians and Surgeons of Ontario. There are a few things like written consent forms that some physicians actually needed to still keep the paper copies of, so they did occasionally file, and still needed paper records often for doing insurance reports, or when transferring paper-based medical records. Even when new patients arrive, some practices still actually make a physical chart for them, the registration form for signing up to the practice, it's a paper document so they tend to keep the original. The following respondents described the experience of working with hybrid medical record system and the toll it took to work with paper-based records.

> *One problem we have in our clinic is there is a lot of scanning so if some things aren't directly in the chart, we have to let them scan. So the Ontario Breast Screening Program, sometimes if they are called back for their repeat mammogram in two years, we just get a piece of paper with a checkbox saying it was normal and then all of those have to be scanned in, and then we have to have someone sit there all day and scan in all those papers across five doctors. And we can get behind. you know, patients want their results next time they're in and they're not in the chart yet. So that can be quite a nuisance. (PSWO14)*

> *I found that when we switched from Healthscreen to Accuro I was probably here for an extra hour and a half, so it costs me an hour and a half of my life every single day. (PSWO2)*

> *It was painful. Yeah, that was a big deal. I think we had a 12 hour downtime, which was weird. We all had to be paper-based for a little while. (PSWO24)*

Several hospital records have remained paper based, and hospitals often do not use structured documentation or synoptic documentation as EMRs in the community where templates and stamps are commonly used. Several respondents who have had interactions with hospitals often must transition paper records into the EMR via scanning: "*It's old school, like paper chart anyway*" (PSWO21).

6.3.1.2 Experiencing EMR transitioning

Participants explained that the process of transitioning from one EMR to another wasn't usually smooth, has not been without hitches, despite the promise by vendors of improved functionality that usually accompanied adoption of a new system.

> *It's a different system. PS seems to have a lot more functionality to it, which is nice. The migration of data, though, wasn't as smooth as we would have hoped. Some things relating to medications, allergies, some of that stuff didn't transition over very well. The last couple of months has been more so getting all the charts reviewed and up to date, but aside from that, going forward I think it is a more powerful system. Definitely a lot more functionality to it. A lot more integration. (PSWO17)*

Essentially, given that physicians had to continue to deliver patient care and ensure minimal disruption to clinical duties, some respondents took advantage of EMR training through webinars that they could watch and attend without having to leave the clinic. Generally, respondents described such experiences as "good" (PSWO 21) or "as expected" (PSWO17). Yet, preference remained for onsite training due to more hands-on nature and ability to address transition issues as they came up. When vendors offered to migrate information in the EMR for free, participants perceived it in a positive light and as a way of indirectly saying "they would like us to use their system" (PSWO19).

Stressing cost of transitioning as important consideration, participants recognized that each system comes with peculiarities which may force the physician on a learning curve.

> *They were looking at if we need to switch to a different system. I think cost was the biggest issue. That what would it cost to get the whole organization to switch over to a different system? (PSWO23)*

> *Their system is in fact quite different than Nightingale. It looks very different. You use it very differently. I would tell you, from my looks at it, it doesn't schedule or bill as well as Nightingale, and now I'm used to Nightingale, I don't like the way that system looks. It presents too much information all at the same time for me. However, I think it probably has some working advantages. Nightingale has had some problems, but I think they all have problems. I don't think there's a perfect system. (PSWO19)*

6.3.1.3 Transitioning as practice changing moment

Several participants mentioned that the experience of EMR transitioning was not smooth: "*Yeah, it wasn't clean. We're still having to figure out how best to clean it up because there's no perfect way to migrate data from one format to another" (PSWO24)*. They indicated that transitioning brought a lot of redundancy, with a lot of little issues related to patient records to attend to. However, there seemed not to be an agreement on the impact of transition on patient care. To some, transitioning did not have much impact on patient care, but it was just more for the aesthetics and efficiency of EMR use. For others, transitioning resulted in more impactful practice changing moments.

> *It's actually sort of a problem, because if they decide to go with a different program that I don't want to go with, in fact it would be our personal preference to transfer to Telus, and that's because of the huge amount of work it takes to get a paper record into an electronic record and then make the electronic record useful. It takes a huge amount of time. Really, it would be a practice changing moment for me if this information cannot be transitioned successfully. I will probably quit, because I can't do this again. I just cannot. In the lifetime of practice, I have left, to make it useful, I cannot start again. (PSWO19)*

A few interviewees found computers generally, and EMRs particularly, frustrating because of the time needed to gain familiarity with certain features. Participants wanted their investment of time and effort to flow through during periods of transition, and for all EMR information to transfer smoothly 100 percent, 100 percent of the time, in a way that they could read and use, without having to switch back to paper-based records. This is because investment of time as a result of transitioning could take time away from clinical work and patient care. Further, when physicians figured that transition didn’t go as smoothly as expected or as planned in other practices, they held off implementing changes to their own EMR.

> *From what we've been hearing is that there's been a lot of issues with the transitioning. For instance, the Nightingale to Accuro transition, we were*

supposed to do a year ago, we held off because we've been hearing about so many problems, we wanted to feel more confident that they knew what was going on. What we heard was that Nightingale would blame Accuro, Accuro would blame Nightingale, and there weren't a lot of solutions. There was a lot of down time. People would find that there's certain things missing in their records. So, we haven't had heard very many confident stories about transitions, so that's why we held off. (PSWO21)

6.3.2 Using regional integration tools

Respondents described their experiences with ClinicalConnect, Hospital Report Manager and Ontario Lab Information System. The main results are presented here, below.

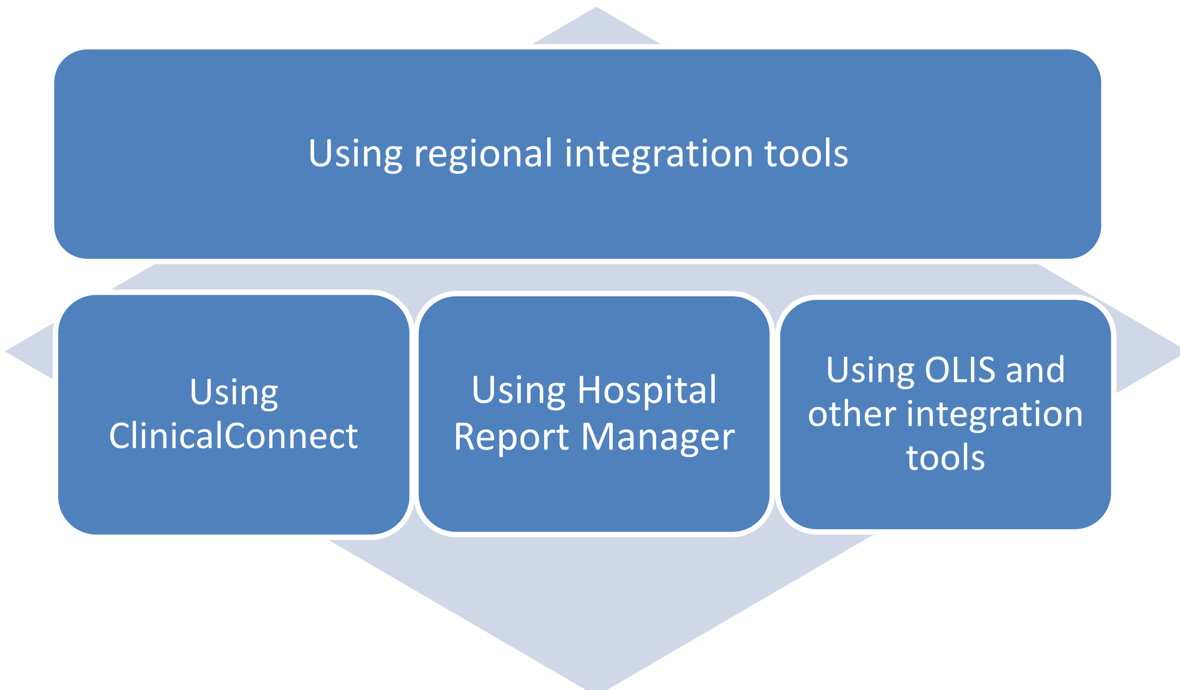

Figure 17. Emergent theme 'using integration tools ' and categories

6.3.2.1 Using ClinicalConnect

Participants described their experiences with registration for, use of, benefits derived from, challenges associated with, and evaluation of ClinicalConnect.

Generally, respondents found signing up for ClinicalConnect straightforward and efficient. Those using ClinicalConnect on a regular basis typically used it to pull in hospital data, lab data and imaging data. "*It's been really great for my practice to use ClincalConnect, my staff uses it, so when the patient's been discharged, they will look for that information before I even go in the room, so I'll have that information readily available." (PSWO1).* Physicians using ClinicalConnect highlighted its usefulness because it allowed access, both by physicians and support staff, to consult notes, lab information, drug repository and a host of other information. A few respondents expressed the view that much of the information provided by Hospital Report Manager and Ontario Lab Information System could also be served through ClinicalConnect, because it kept reports and tests together for easy access.

In parts of the region such as Waterloo-Wellington, leadership for implementing and deploying ClinicalConnect spearheaded by the eHealth Centre of Excellence oversaw its expansion and use among about 4000 users. Prior to dissolution, each Local Health Integration Network would have a team of individuals who talked to clinicians about ClinicalConnect and how to use it, while supporting clinicians with their workflow. Not everyone found registration for ClincalConnect straightforward and not every physician using ClinicalConnect described it in a positive light. Some participants described the process of registration as "clunky" (PSWO15), requiring several email interactions and signing agreements with ClinicalConnect's headquarters in Hamilton, they would rather interact with representatives locally to smoothen the process. Despite being touted as an integration tool, participants decried the extent to which ClinicalConnect was integrated with the EMR. For example, physicians working in the community and those without hospital privileges could not contextually launch ClinicalConnect from patient charts within the EMR. If the physician were working in the patient chart, with contextual launch the physician could have access to their patient's record directly from the chart without the need to log in through a separate web portal. Users mentioned that because the tool usually took them away from the EMR, it posed a challenge to ease of use when they had to log in to a different system. Information retrieval through ClinicalConnect was described by some participants as slow, partly because the system had to retrieve information from different sources. Moreover, differences existed in roll out of and access to ClinicalConnect across the region, leaving some respondents reluctant to install the integration tool. For example, physicians in practices where majority of patient population was locally served using information resources available locally in the community didn't use ClinicalConnect as frequently as those serving patient populations coming from various other parts of the region.

Generally, respondents found ClinicalConnect worked well in hospital settings but bulky and difficult to use in the community because it functioned like a different system. The following sample quotations about ClinicalConnect highlight a few respondents' impressions.

> *It's well intended, it's just taken a long time to roll out. If you use it works well, but it has an awful lot of electronic barriers. It's a different silo. There are many different silos (PSWO8).*

> *Data that I usually retrieve from ClinicalConnect, I'm going to say OLIS data and DHDR. Digital Health Drug Repository or DHDR, it's a medication repository for all drugs that are paid for by the government in the province. It's dispense events. I can see every event of when those medications were dispensed and which pharmacy you got them at. It also has narcotics monitoring system. If you're on medication for chronic pain, I can see all of those medications. (PSWO10)*

> *If I got a palliative consult to see a patient and they were being seen by oncology in Hamilton, I would look for their consult notes. So the progress notes, the histories and physicals and any imaging documentation that I could get. So those are the big things I retrieve from ClinicalConnect. Lab work, I could just repeat the lab work here and so it's not that important for me, but those are the things. Mostly, what the oncologist said, what the plan is and maybe what some imaging said, if they had an MRI or CT at another location. (PSWO13)*

> *We have ClinicalConnect. I tend not to use ClinicalConnect that much because I find that ClinicalConnect is really thin in terms of the information that it has, whereas when you're using the hospital server you have access to all the investigations and all of the records from the specialists and it's much more*

robust. It's very, very valuable. When I'm really stuck, like if somebody is from out of town, then I might fall back on ClinicalConnect. (PSWO2)

Personally, I don't use ClinicalConnect. My admin staff does. Before ClinicalConnect, we would contact Medical Records and ask them for records, sometimes they would do it, sometimes they wouldn't. With ClinicalConnect, when it works its pretty quick. The idea is great but it's inconsistent. (PSWO6)

So Clinical Connect works well at LHSC because it's integrated into the hospital system. In the community I found it difficult and bulky because it's a completely different system. If you're in a private office in LHIN 1, your LHSC information doesn't get to you, so you have to go through Clinical Connect to get it, or they have to fax you the results of the discharge, something that has to then be entered manually into your system. So, there's a lot of disconnect between big systems and important ones, and that's all electronic barriers. (PSWO8)

ClinicalConnect has filled some gaps, to some extent, when we talk about integration, the logical element of this data needs to make sense… ClinicalConnect as an interface is not user friendly for day to day clinical care. You really have to set aside time to go there, you search, every time you click it's a few seconds wait. It's not made for performance and the information is not organized in a way that is usable for primary care physicians. (PSWO4)

I use ClinicalConnect, mostly, out of the nursing home site because it allows us to access information on our patients that, you know, when they get admitted they're coming from various places, other nursing homes, from hospital. (PSWO9)

Some respondents found its performance very slow as it timed-out frequently when they tried to access information. Apart from performance, reliability and end-user interface, when the product worked well, participants overwhelmingly agreed that it delivered incredibly valuable information. Respondents who could obtain information from other sources or used locally available sources didn't use ClinicalConnect, as PSWO12 attested to:

> *I do not use Clinical Connect. I have not seen the need for it because the data, most of my patients are locally based, and the referrals that we send are also local, so really we just, 90% of the information that we need is available, 90% of the external information is available locally. My colleagues who are involved in the hospital care of patients need Clinical Connect to get data from London and elsewhere if the patient has been elsewhere. It's very rare that we don't have data on our patients from other, more distant places like London, because if I refer someone to a consultant in London, they send me a consultation note, which arrives through the fax machine and is entered into the patient's chart directly. (PSWO12)*

Commenting on the experience of evaluating the use of ClinicalConnect for reliability as a clinical system, participants welcomed the opportunity to investigate the tool as well as related tools, to determine direct benefit to primary care practices. Beyond evaluating through benefit realization cases, respondents mentioned hiring a third-party audit firm to evaluate performance of ClinicalConnect to independently examine areas of use such as frequent time outs of queries. Participants further suggested exploring similar viewers in

Ontario, such as Connecting Ontario viewer, to look at ways of learning from implementation and adoption that Connecting Greater Toronto Area and Connecting North East Ontario hubs were leading, or perhaps explore integration of clinical viewers across the province. The overall consensus was that making ClinicalConnect valuable and easy to use would require training people on it and supporting them with understanding where it could help them in their practice, and making things easier so that users don't have to hunt and gather information, or waste time while using it.

6.3.2.2 Hospital Report Manager

Participants stated that Hospital Report Manager (HRM) directly took reports from hospitals into physicians' EMR, saving time and effort which they no longer spent waiting for reports to arrive from hospitals or having to search for reports through other means. "*We are using HRM. If a patient gets identified at Stratford, its coming through HRM, whereas previously it would have come through on paper*" (PSWO20), "*HRM is secure and it fires right into our system" (PSWO2)*. Citing cost, participants who didn't have or use HRM did not get reports directly into their EMR unless the hospital sends a record.

> *"HRM is free but to integrate it the EMR Nightingale was charging us $25 per person, per month. So, that would be an additional $150 for the practice per*

> *month. Times that in a year and it would be $1,800, and we decided as a practice not to do that" (PSWO21)*

Reports arrived within minutes into the EMR via HRM as soon as they were transcribed by the sending facility. Interviewees asserted that the value of sending reports straight into the EMR was related to completeness and timeliness of reports being sent. Sometimes what happened was that if somebody dictated a note at the hospital, it became a preliminary note and they may not send the preliminary notes to the family doctors. Some specialists might fall a little bit behind in terms of signing off on their notes, and if a note gets done by a resident or they wound up shifting off service, it's may never be clicked off as being complete: *"So sometimes we won't get things, or have to hunt them down usually six months down the line. Preliminary notes we don't receive" (PSWO2). "HRM is an improvement, but again there's limitations to it. It's as good as a person dictating on the other end" (PSWO3).*

Emergency (department/room) information was highlighted as a problem area because of very little electronic documentation on the EMR at the hospital. Physicians still receiving faxed copies of reports available through HRM cautioned against duplication of records. Other than the few that have implemented an emergency department information system, emergency room documentation is done on paper at several hospitals.

In summary, there are gaps in terms of care documentation that primary care physicians are more aware of because of the implementation of the EMR and integration tools like HRM.

6.3.2.3 Ontario Lab Information System (OLIS)

Respondents described the Ontario Laboratory Information System (OLIS) as the biggest game changer among all integration tools because it allowed clinicians to search per patient, to look at lab tests. Even in situations where a patient couldn't make it to the clinic or missed primary care appointments, the physician received direct lab feed from the labs. "*If a patient had a lab test a while ago, I can pull it in now through OLIS, and I can also see if some other specialist ordered it, I can pull that in too" (PSWO1).*

Respondents appreciated having multiple means of accessing OLIS despite lack of full integration.

> *We have two different ways of accessing OLIS data today. One is a fully, well it's not integrated per se, but a viewer that is a direct link to eHealth Ontario to the repository. If I'm in your chart and I push the OLIS button, I can go and get all of the OLIS data and bring it back into your chart. It's only a viewer so it doesn't bring it into your chart. It's not integrated. The other way is if I push the Clinical Connect button, but then it's coming in through a federated model where it goes out and gets all the other sources at the same time. (PSWO10)*

OLIS was described as helpful because information comes in as a graphable kind of discrete data, so physicians can compare to previously available information. Physicians used OLIS to scan through the information feed to view and transfer lab information through practitioner query, which is automatic transfer. Lab feeds usually out from independent labs, not hospital labs. OLIS practitioner query not only automatically feeds the lab data to physicians' EMR, it also helps physicians close the loop on missing lab data. Respondents used the patient query within OLIS as needed, usually to pull up patient information of their patients or patients that they see. It was useful to these respondents to have access to OLIS data daily, and in real time, as OLIS updates the charts, or replaces lab feeds with new information as it becomes available.

Respondents relished the ability to access lab data irrespective of where the patient got the lab work done right across the province. Moreover, they relished how OLIS has been helpful in reducing the occurrence of repeated lab tests which used to happen in the past where lab results were not as readily available.

> *Having the ability to have access to all the labs that were done in hospital is very, very useful, not only for clinical value, because I'm convinced it actually improves clinical outcomes, but in terms of stewardship and not repeating the same labs. If someone's already had labs done two days ago, I know they have so I don't have to order hemoglobin level or another creatinine, another kidney function test, I don't have to do that because I've seen they've already had that done. It's reduced costs in terms of test ordering for sure. (PSWO20)*

OLIS has been practice changing for most physicians. When a patient is seen in hospital, for the caregiver to be able to follow them remotely, for the physician to be able to follow up after discharge to see what has been ordered and what hasn't, is practice changing. Inevitably, compared to OLIS, reports that arrive from hospitals, whether discharge summary or paper notes, do not always effectively convey. Having the ability to access all the labs that were done in hospital is very, very useful, not only for clinical value, but because it actually improves clinical outcomes, both in terms of stewardship and not repeating the same labs. For example, if someone's already had labs done two days ago, the physician knows they have so they don't have to order hemoglobin level or another creatinine, another kidney function test, the physician doesn't have to do that because they've seen it's already been done. According to respondents, it reduced costs in terms of test ordering. Another value of OLIS occurred when physicians were taking on new patients, as they could go back and see every lab they've had done since year 2000 and download what they wanted into the EMR.

6.3.2.4 Other integration features

Participants reflected a growing understanding that connectivity is vitally important and recognized the need to integrate both at local and regional levels. Patients tend to stay in their region and for that reason, most participants expressed that on a regional level, most patient encounters and patient histories would and should be maintained at that level.

Integration efforts need to be directed locally by establishing relationship with clinicians and clinicians need to trust implementers of integration tools and systems. "*It needs to be contextualized locally" (PSWO1)*, meaning problem solving need to be understood from the perspectives of the frontline clinicians. For example, if a physician is having trouble with getting psychiatry referrals and they needed help with that, the EMR needs to support that effort. EMR data are not being leveraged to their fullest extent because the EMR is being used as an electronic version of a paper record despite ability to search, to use reminders, to enter limits to monitor patient population or increase screening rates, to determine what tests to do and what tests to not redo. The aim should be to leverage the EMR to do more appropriate testing and support clinicians with more effective practice.

Features of integration figured prominently in participants' discussion of EMR. Some participants advocated for a single point of integration which would be the patient. Under this arrangement, rather than having multiple points of integration, a single point of integration ensures that the risk to privacy, security or system failure is minimized.

> "*Let's say you show up and you show me a fake ID and completely bypass me because you have an evil intent to snoop at someone else that looks like you somehow. The worst-case scenario is that I break confidence with one patient, but not a big Infoway-type honey pot, as we call it" (PSWO16).*

6.3.3 Managing patient expectations

Respondents were of the impression that patients perceived electronic health information integration to be more advanced than it is. This theme identified physicians' attitudes towards patients' access to their own health information. Attitude here is used to mean the manner in which physicians think or feel about patient information. While some primary health care physicians see themselves as custodians of patient health information, others feel patients should be at the center of integration, and in order to deliver best patient care, it is important to view information about patients in the EMR and other sources as an extension of the patients.

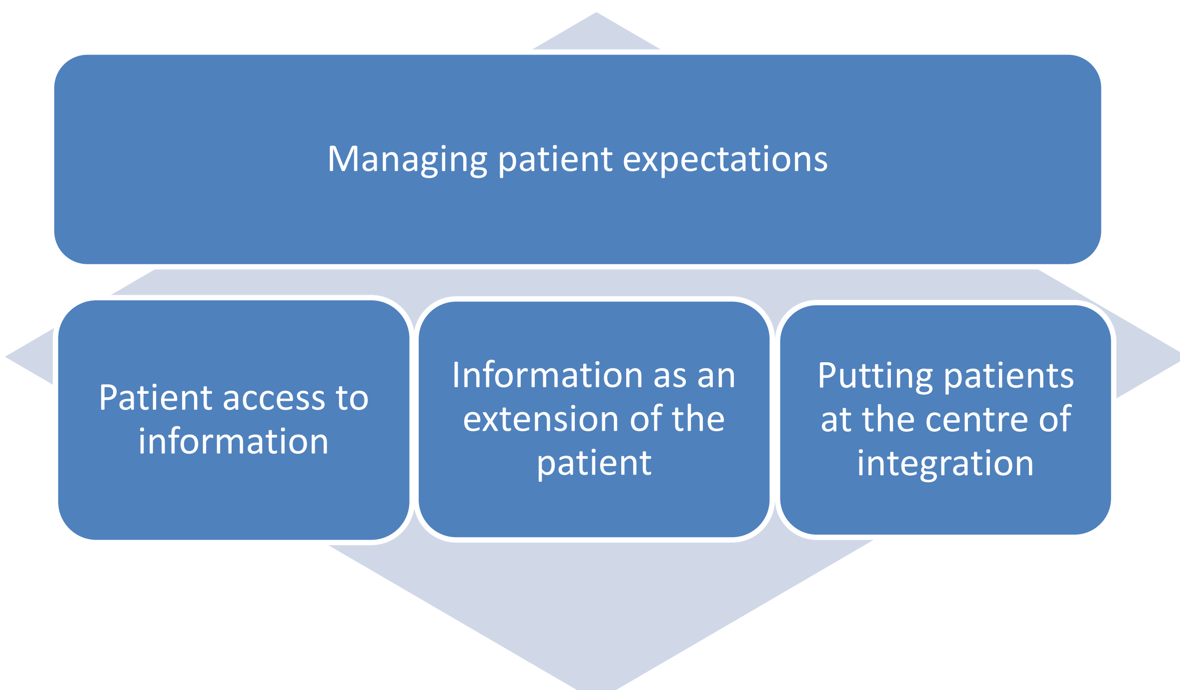

Figure 18. Emergent theme 'managing patient expectations' and categories

6.3.3.1 No news isn't always good news: On patient access to own health information

Participants described their perception of reasonable patient expectations about availability and access to information pertinent to their care. While several respondents stated that patients should have access to health information in the EMR, many indicated that the primary custodianship of information should remain with the doctor. For example, PSWO15 believed patient should have access to their information but not have ability to change it, while PSWO 17 and others indicated the value of having the physician available to interpret accessible information to patient.

> *Most of my patients, they rely on the doctor to tell them about the labs. I know even some of the labs, for example, allow patients to sign up and get their results. Some people ask me about the labs. They're like, "I can get my lab results." I'm like, "Yeah, I'm okay with you doing that. Just be careful reading them because… It's happened already. They call the office panicking that they see a number abnormal. Then you look at it and say it's nothing. It's not clinically relevant. (PSWO17)*

Sometimes, patients expect physicians to have information that they may not yet have, and there are patients who not only are well educated but have developed interpretive ability because of familiarity with their own health information. "*There are diabetics that* *really know what a good a1c reading is. When they see that number, 7.5, they feel great. They see it's 8.5, they feel awful. They understand their illness, so they can take those numbers and learn from them"* (PSWO17). There are others who expect more information than is available: "*They're like, we think this, but they don't know about the findings on the chest X-ray, blood work, it's a bit more inconvenient for patients for sure, because they expect us to have that information and then we don't." (PSWO21).* Respondents clamoured for some level of education at some point for patients, but who was going to deliver that education aside from physicians, remained open to debate. For example, usually when patients present at the clinic to review lab result, physicians go through it with them. They can even see on the screen. *"Some of them will say, "Why is this red?" "It's red because of this, but it doesn't actually translate to anything illness wise"* (PSWO17). The typical approach to mitigating some of what is termed "unnecessary anxiousness on the part of patients" (PSWO17) is to inform patients and go over information with them. PSWO2 described this proclivity as follows.

> *They have access to the information, so it belongs to them, and my inclination is that, yeah, if they want their charts then I typically would give it to them. I would say if you have any questions about it, please let me know. I have no problem giving charts to the patients as long as they agree that they'll come speak to me if they have any questions about anything. Certainly, if another doctor's office asks ,as long as they're within the circle of care, if they request records then you send them the record.(PSWO2)*

From EMR integration standpoint, implications of patient access to information are enormous. First, respondents highlighted that some patients do get anxious about their results understandably, and so it's always a balance of whether physicians want to bring in every patient after every single test to interpret test results, or patient information that could easily be misinterpreted, or information with minimal clinical relevance. This would take time away from more pressing clinical duties or seeing other patients. Even if primary care physicians delegated such to clinical staff, for example, to mail or call anxious patients, reaching patients by snail mail or phone calls may require several tries since calls or traditional mail don't always have guaranteed messaging receipt capabilities. It is more efficient to integrate patient connectivity with the EMR so that physicians can directly interact with patients or send quick messages to them using secure messaging features. Second, without direct patient-physician communication, possibility of losing pertinent information increases, sometimes with mortal consequences, as PSWO22 succinctly described, while relating the story of a patient who eventually died partly as a result of lack of information follow-up:

> *Me, and I think a lot of doctors now, we don't say "no news is good news, don't worry about it" because I worry that things might get missed. We have the ultimate responsibility, but I try and at least let the patient know to not follow that no news is good news approach. It is more efficient if I could just message my patient directly to confirm that things are fine, and then it's done and have some*

confirmation maybe that they got the message. If I can do that through the EMR, would be ideal. (PSWO22)

6.3.3.2 Information as an extension of the patient, and putting patients at the center of integration

Certain participants proposed putting patients at the center of integration as the solution to ensuring that benefits of fully integrated EMR are realized. Part of the reasons cited were changing patients' expectations and new perspectives on information on the part of patients. It's no longer only about access, but also about control of health information, as the following quotations illustrate.

> *There's a proposed community supported system in Chatham, Essex. The idea, which turns our whole eHealth thing upside down, is to put the patient of the center of integration. If you want to get around the whole problem of privacies is to put the patient in the center. You would never achieve integration by trying to negotiate otherwise. It's hugely expensive. (PSWO16)*

> *You know you have patients who want control of their information, "I don't want this information in my record. I don't want this information sent out. Why can't I have all copies of my information, so you don't have any copy of my information that's out there." So there's that whole new view on information. (PSWO3)*

Relating patient information to patient care, participants opined that following information was tantamount following care, referring to caregivers' ability to extrapolate care from patient information by viewing patient information as an extension of the patient. When patients bring their own information to the clinic, it provides opportunity to better assess and follow their care. Further, when patients bring their own information to the clinic, integrating such patient information into the EMR is essential to patient care. However, physicians only have rudimentary ways at their disposal to integrate such information to the EMR. For example, when patients bring in blood pressure logs, blood glucose monitoring records, etc., respondents indicated that they scan the paper into the EMR or save as an image in their record. If patients bring something that looks like it should be integrated in, then typically, it will get scanned into their record just as information on disks or images on disk would be saved in the clinic computer system. Most EMRs in primary care practices do not integrate with email so physicians cannot electronically enter information received from patients via electronic messaging. Yet, respondents emphasized the need to be careful about communicating via email because email can be read by the internet service provider and generally not considered to be secure. Fax is considered more secure, as such, communications are often converted into fax messages, especially when communication is between regional health organizations.

Respondents decried the lack of integration despite patient expectation of fully integrated regional EMR. PSWO10 asked patients what they thought physicians had access to and found that patients thought physicians could see a lot more information that in actuality. though patient perception.

If you're my patient I'm sitting here on the computer, you go, "oh that guy knows that I saw that doctor in emerge last night. He knows that the doctor gave me 100 Percocet last night." Meanwhile, none of that stuff I can see because we don't have an integrated system. We have these siloed instances of health information that don't talk to each other, but patients expect they do. When you go to a bank and you stick your CIBC card in at the Bank of Montreal, you say, "I'm going to take $1,000 out because I just took $1,000 out there and I'm going to take $1,000 out here." They go, "No, you just took $1,000 out over here, you can't take $1,000 out over here." People think that's the same way it works in healthcare. You just got 100 Percocet from a doctor down the street. I can't give you another 100 Percocet. What are you thinking? (PSWO10)

6.3.4 Engaging regional entities

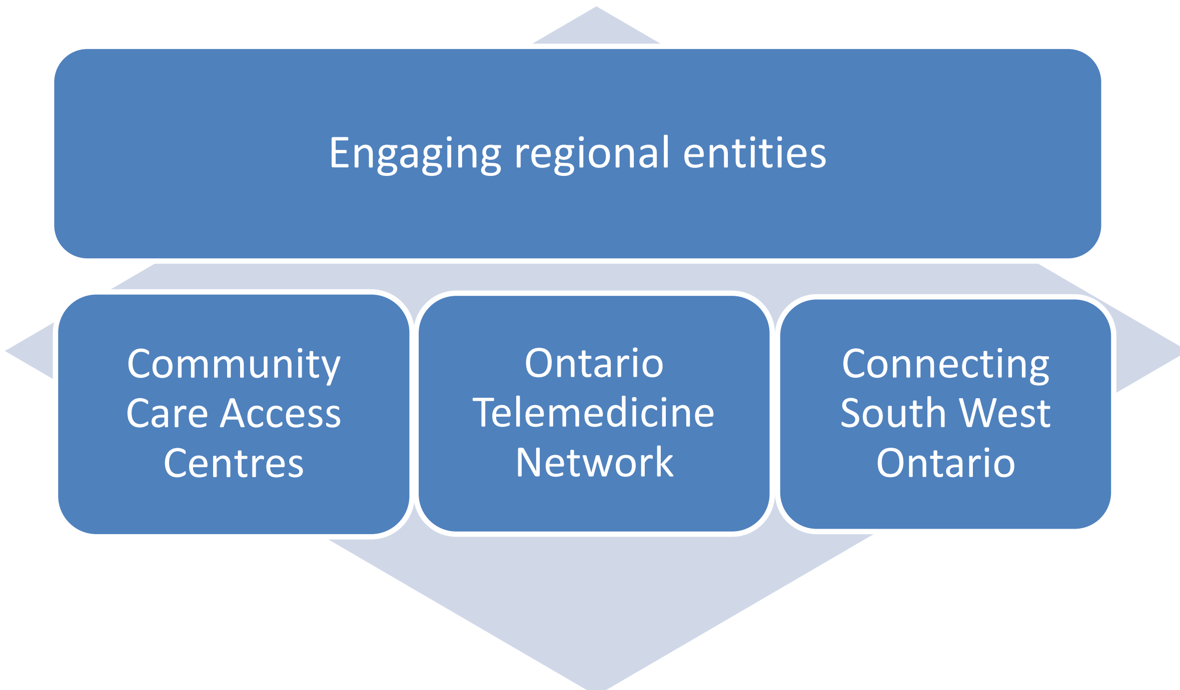

Figure 19. Emergent theme 'engaging regional entities' and categories

Regional entities here refer to organizations in the region that primary health care physicians interact with while carrying out primary health care duties. Typically, engagement with a regional organization is contingent on availability of support for EMR integration and use, and participants described connectivity with regional entities as dismal. For example, communications with Community Care Access Centres (CCACs) and some nursing homes were often done outside of the EMR due to heightened awareness of the privacy and security implications of communicating with other organizations. “*You have to be very careful about communicating with other organizations because of privacy laws. We're not supposed to communicate by email because email can be read by Homeland Security or your internet service provider*” (PSWO2). For this reason, some respondents expressed the importance of cultivating real, cordial relationships regardless of challenges of electronic health information connectivity. “*CCAC had some people who would come in and ask what sort of questions do you have? They would help you answer your specific questions and help you learn things. That was tremendously valuable (PSWO2*

Similarly, Ontario Telemedicine Network (OTN) provided opportunities do teleconferences when a patient would come in and instead of sending them to a specialist in places like Toronto, physicians could take care of them over the internet: “*Dermatology, if someone comes in with a rash, it's hard to see a dermatologist but they have this system where you can take picture and then you can send it to the dermatologist” (PSWO7).* However, experience with Ontario Telemedicine Network (OTN) posed difficulties to some respondents stemming from lack of integration with EMR: *“I have to I go through four steps to get to the OTN an email site and I'm sorry, like I'm busy. So forget it, I'll just send a consult or a call*” (PSWO13). A physician with access to the phone number of a specialist might call but its hard for those specialist who physicians can’t call so it would be a great leap forward for the OTN system to be integrated with the EMR: “*It would be great if it actually integrated with my Accuro, because I would use it* (PSWO13)..

Regional entities included organizations at the forefront of implementing ClinicalConnect, HRM and OLIS. Respondents were generally aware of activities of such organizations, and while some participated in programs by regional entities, most had limited interaction. *"Connecting Southwestern Ontario, it’s sort of the whole team to deliver Clinical Connect to Southwest Ontario (PSWO10).* With colleagues in different parts of the region, some respondents were of the opinion that different parts of the region experienced different procedures leading to inconsistent outcomes across the region (PSWO15).

Integration with regional clinical entities such as walk-in-clinics was indicated as an area of concern. Respondents would like better integration with walk-in-clinics Patients go to walk-in-clinics probably because of proximity of location or the extended hours of operation compared to family physicians working nine to five. So, if patients weren’t able to go in for an appointment in a day, they may stop by at the walk-in. Yet, if a patient goes and sees a walk-in doctor, the primary care physician doesn’t get any of the information. Its comparable to a black box because there’s a whole series of information that the physician might not know or have access to. According to PSWO14, *“there's no* *integration with walk-in clinics, and because I'm in a Family Health Team, I just see that pay's been deducted off of my salary but I don't know why they went to go see someone else and what their symptoms were".* It's more concerning with patients who may be addicted to medications and primary physician doesn't know what they're prescribed or what their complaint was and doesn't know if a prescription was given by a walk-in clinic doctor. PSWO7 expressed similar experience with emergencies: *"I do have trouble with some of the emergencies such as Kitchener emergencies, Woodstock emergency, where patients of mine are seen, and I don't have any idea why they are seen*" (PSWO7). Some respondents received reports of blood work but had no idea where it was from, and so there are not only problems with integration with walk-in clinics but also delay in access to information from emergency departments in the region. In situations where patient information wasn't forthcoming, primary care practices have had to call the walk-in clinics to obtain information about their patients who might have had encounters with such clinics.

Respondents lamented the lack of integration with pharmacies. "*Medication is a big thing for me and the fact that it's not integrated, it's not connected to any other system*"(PSWO13). Comparing pharmacy system in Ontario with other provinces, PSWO13 would love to have the pharmacies all like in provinces such as Manitoba, where they're all connected to the same system, and that's also connected to the physician’s system so that the medications are updated, and reduce occurrence of medication errors. *“ People are getting wrong doses and we have bad outcomes and we know that medications cause huge bad outcomes*” (PSWO13). It’s a “huge” issue with other regional entities as well as in the hospital, with medication errors, because patients go in and the medication that they have on the list in the hospital might not be the right medication, or it has been inputted incorrectly via manual input.

6.3.5 Identifying support sources

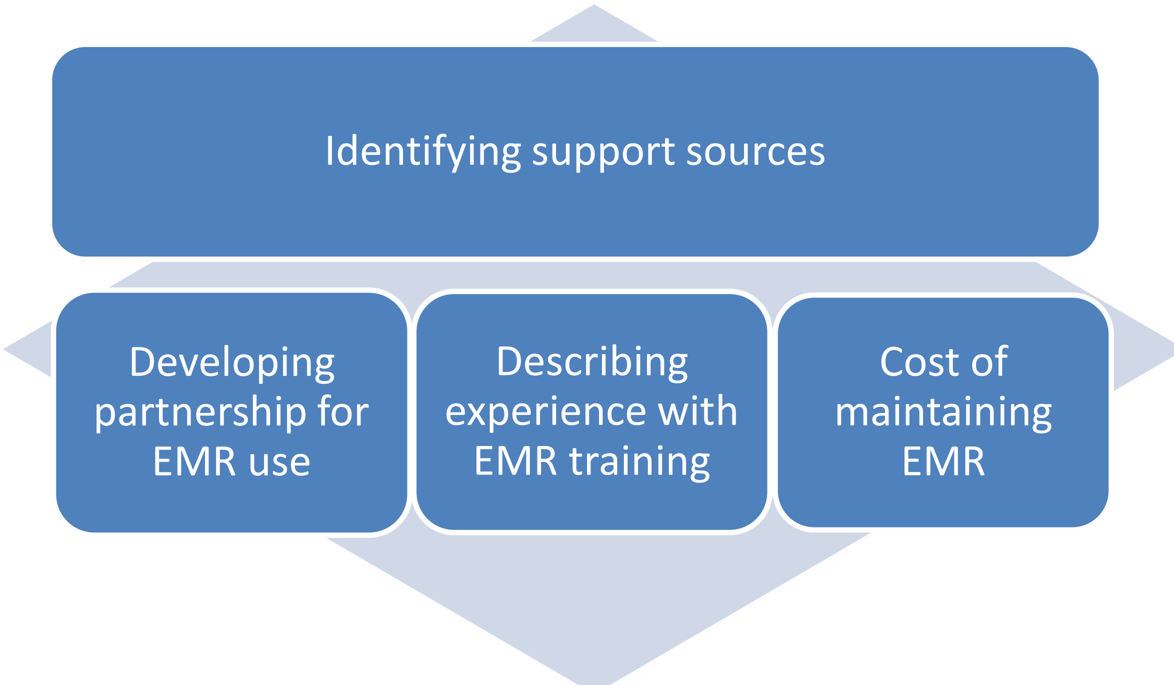

Figure 20. Emergent theme 'identifying support sources' and categories

6.3.5.1 Developing partnership for EMR use

Respondents identified few support sources available to them for EMR use. Despite availability of those few support sources, one of the main challenges expressed by participants still remained the question of support. Ideally, support would involve using clinical social networking to provide physicians ability to interact with other physicians to meet, discuss and verbally network and intermingle: *"We don't have that anymore, there is no social networking available to allow that in a clinical sort of way (PSWO3)*".

By developing partnerships for EMR use, either in the clinic, or through interaction with community, regional and provincial organizations, some respondents were able to leverage available support resources to improve EMR use. For example, PSWO11 related the experience of having dedicated EMR meetings once a month with colleagues in the clinic where they talked about how people were using the EMR, and how they could be using it more efficiently or in a more standardized way so that clinicians were consistent in a way to make data retrieval easier. PSWO 20 participated in dashboard working group to advise vendors on criteria for dashboard design. Even participating in the formal process of request for proposal to get vendors was seen as an opportunity to have input on the kind of support that physicians received.

Support may involve cost of acquiring and maintaining an EMR, especially for new physicians who may not have received funding to adopt an EMR. It could also be related to everyday use including technical support from EMR vendors, support received through programs by professional organizations such as OntarioMD, support related to training, as well as support or lack thereof at the practice level.

Experience with peer support for EMR use was described as typically collegial and unofficial, sometimes coming from superusers or admin staff. According to PSWO12, *"it's more informal, although with our superuser EMR specialist, sometimes he will have sessions with us and show us new tools that he's added to the EMR, or old tools that are there that we're not using".* In some family health teams with staff which tended to change over fairly quickly, the admin staff is sort of the go-to person. "*She's the one who communicates most with Nightingale and that kind of stuff. So if there's a problem, we first ask Jen*" (PSWO19). In more formal settings, EMR support could be incorporated with regular continuous medical education (CME) activities because such training sessions for often brought together EMR users from different areas of the region. A few respondents already used the opportunity to catch up on EMR use:

> *I just went to Sarnia to do some extra training for palliative care and the manager there told me about the warnings for the medicine, because they had the same Accuro, so she went to a training thing about it and so we were able to kind of talk about what they do and what we do, so we're always doing that(PSWO13).*

OntarioMD programs serves as a support system for physicians using the EMR (OntarioMD, n.d.). Most respondents have received or participated in regular survey of physicians for the Ontario MD maturity model used to assess level of EMR expertise. The survey, done every year, included gap analysis and focused more on where the physicians were in terms of EMR use. It typically included quantitative and qualitative questions which took participants about eighteen to twenty minutes to complete. OntarioMD progress assessment used ten key measures to evaluate practice management, information management and diagnosis and treatment support to track progress in EMR use against the maturity model. The practice enhancement program focused on clinically relevant quality improvement where people dedicated to the work from OntarioMD took physicians through a defined practice enhancement program to drive clinical value to a higher level of patient care.

Participants generally expressed positive views regarding OntarioMD programs, specifically the peer leadership program. The peer leader program is a program where physicians who are seen as leaders or considered experts in utilizing EMR on multiple different vendor platforms across the area provide one-on-one guidance to physicians and physician groups who were looking to optimize their EMR functionalities. As PSWO15 and PSWO21 stated, "*when we were looking at different EMRs, whether to use Telus PS or Accuro, they did introduce us to peer leader for both of them, we did sit down with a peer leader, which was really helpful*" (PSWO21), "*we did benefit from people that came through the family health team, they showed staff how to extract data from the EMR, how to do some small quality improvement projects, so we did benefit from that" (PSWO15).* More advanced users expressed that the peer leaders could delve more deeply into EMR use. Peer leaders function independently. It could be an opportunity for future growth where advanced users, vendors and peer leaders develop and nurture closer relationships.

PSWO20 who happened to be a peer leader described the peer leadership situation as follows.

> *In our area, there's two of us who are on TELUS, one who is on Accuro, one who's on Nightingale. The issue becomes that, we are supposed to be independent, in terms of not favoring one EMR over another. I use TELUS. I show people how to use TELUS. For instance, I worked with a group once who was looking at what EMR they wanted to transition over to. I did a demo on TELUS. They are welcome to email me with little questions, here and there. I'm not paid to answer those questions necessarily, but I'm happy to answer them. The idea of peer networks is really, really important for this. The vendor won't provide free services indefinitely. (PSWO20)*

Some EMR vendors have community portals where physicians can ask other physicians for help on certain things pertaining to EMR use, ask the vendors online for certain issues that they're running into or make suggestions to the vendors for things that they would love to see. The approach that a peer leader would take to addressing such issues would be much different than if someone were actually to sell the product. Where the peer leader would be more honest about the pros and cons of using an EMR, the salespersons approach would be much more aligned with getting the product sold. Therefore, having a closer relationship with vendors and users could be useful as long as certain barriers are still maintained, particularly with regard to peer leaders receiving incentives or payments from EMR vendors. This is particularly important because physician training on EMR is generally insufficient. Training is insufficient in terms of what the vendors provide. "*The training that we were provided was essentially, one morning with the whole staff. Then periodic follow-up for a couple hours after that. It's not nearly enough to actually learn as much as you need (PSWO20).*

6.3.5.2 Describing experience with EMR training

Some primary care practices have in house training for new employees, students and residents to receive mandatory training on EMR use. "*When I first started using EMR, I did receive an afternoon training session done in-house by one of the other physicians*" *(PSWO11).* For the most part, perception of physicians on vendor instituted EMR training was poor: "*It's plugged in, people walk away, its not done in an in-depth systematic way*" (PSWO1). Participants indicated that EMR vendors often include hidden features for which they expect users to pay for additional, special training to learn.

> *EMR providers run courses where you pay thousands of dollars and they'll teach you how to use your EMR and they teach you all these sorts of hidden things. You, as the physician, you're the paying customer, when you start engaging in that then you're really in trouble because you're telling your EMR provider that if they hide more stuff then we'll pay more money." (PSWO2)*

When users paid for training, respondents indicated deriving tremendous value in terms of being able to wrestle the EMR programs down and do things a bit faster and access additional features much easier. Respondents found it beneficial to have people teaching them how to better use EMR. However, training provided by vendors were often perceived as time consuming, and as such made respondents feel like they were just learning a lot of things that were not needed by doctors per se, or some things that front staff needed. Features that physicians found relevant were not often posted online and not easily accessible, and full-day training sessions or using dummies for training were perceived as ineffective: *"we got a little bit comfortable with using the dummy system, but when we saw the real meds and the real labs flow through…you're almost relearning it again. That was one of the downsides of the training" (PSWO17).* It was important to respondents that physicians have appropriate training. However, while somebody who really likes computers may learn very quickly, somebody who is not comfortable with computers may learn very slowly. It may be hard to tailor EMR teaching or training. Respondents indicated that being self-motivated in terms of seeking that teaching was necessary. Since a huge amount of money gets spent on servers and computers, et cetera, and there is a lot of powerful information residing in those servers, in order to access that information, you have to have the knowledge of how to use it. *"I tried to become as familiar with the program as I can without going on one of these trips that cost thousands of dollars (PSWO2).*

The more people who have used EMRs from different settings interact in primary care settings, the more opportunities to share, leverage and derive benefits from training. In some cases, residents shared new EMR knowledge and skills to help reinforce use of features that regular physicians might not be familiar with:

> *The fifth resident showed me the oldest app, that I didn't know was here, and my first resident was able to create some packages so that in terms of labs when I have an antenatal I can just do my prenatal package now, which I would have never figured that out now, so I would have been still clicking to do, this is the blood test that we needed. I would have done it all individually. (PSWO18)*

Training for regional viewer ClinicalConnect allowed users to learn how to access information that they may not have access to otherwise, and doctors who worked at hospitals had training sessions for the use of Clinical Connect:

> *I had individual training with ClinicalConnect. A lot of the hospital-based physicians are familiar with it. I don't know how well the community-based physicians are familiar, but it's becoming a tool more and more used in the hospital setting. Our computer system in Windsor is not going to have anything. Our hospital system is only local. Then access to Clinical Connect, it gives you an opportunity to at least get some information that maybe you can't get from the patient directly*. (PSWO17)

6.3.5.3 Addressing costs of maintaining EMR

Participants indicated that funding for EMRs impacted on their perception of EMR adoption, and in terms of cost with hundreds of millions of dollars that the province put into EMRs, the perception of benefit has been that users have not reaped the benefits of them as much as they should have. There was a funding program for about 30,000 dollars to each clinician to sign up for EMRs and then there's regular maintenance fees on top of that. Recognizing this as a significant investment, respondents were of the opinion that EMRs are at a point now where users should get more from the EMR to show the value of that investment. Knowing that lack of patient engagement was pervasive, some respondents lamented funding technology without funding how the actual patient's get engaged with the portal: "*If patients are asking a question and no one is answering them on the other end, it's not very useful. And so that's really the key piece*" (PSWO1). Moreover, the initial incentives to adopt EMR did not include maintenance costs, so several practices have to include EMR costs with overhead expenses. When electronic medical records were first starting up in 2007, the government provided incentives to have people switch over to EMR's. and several of the participants switched over within that time period because there was some government subsidy to make that transition. The initial adoption incentive was followed up by a monthly stipend for continued use, until that stipend was discontinued in 2015. *"Initially they were giving us some funding that helped us to pay for our servers and for our hardware. That's gone now, I shudder to think about what's going to happen if our server dies." (PSWO2).* Beyond government funding, some practices in urban centers in the region received a head start in adopting EMR through participation regional research programs such as the Delphi program where the hardware was provided by and belonged to the university in exchange for access to clinical data for EMR research. Practices in small towns and rural areas in the region tapped into community support to fund EMR adoption and maintenance. For example, in one rural community, a community health organization owned the building that housed the primary care practice and rallied support within the community to raise funds for the clinic's computers because their reason for existing was to attract physicians to the community and support physicians to stay in the community:

One of the things we negotiated 10 or 12 years ago when they took over the clinic was that they would try to keep the place up to date and attractive to doctors and one of it was funding the computers. Making sure that we had up to date computers. (PSWO7)

Despite the seeming inconsistency in funding programs for EMR, respondents were clear that the value of the EMR is such that physicians will continue to pay for it because it's so valuable that even if they raised the rates, EMR users would never go back to paper charts. Should there be incentive for physicians to continue to use their EMR at a high level? Of course, there should be because in the absence of that the only motivation for physicians to use their EMR to its full extent may be what value they see clinically, but without that incentive it's trickier. It is important to note that some participants did not view the cost of maintaining EMR as exorbitant for every physician, should they not receive incentives.

It's a small spend, just like when you look at a family doctor's office tell you how horrible it is that they have to pay $10,000 to maintain their system every year and it costs them ... you go, "How much money do you make in a year? How much value does that system bring to you?" They'll whine about the $10,000 they have to pay to maintain their system. (PSWO10)

We absorb those costs now, whereas before those costs, we were reimbursed by the government. It means that I take home less money, but I take home less money anyway because they reduced our fees by 2.5% two years ago. I practice medicine because I love it, not because it pays me well. It pays me. I'm happy. (PSWO12)

For doctors starting out who don't have incentives for EMR, it is a big expense to get going and to continue, for that reason, respondents who were early-career physicians were more attracted to open source EMR such as OSCAR EMR.

6.3.6 Meeting information needs

Meeting information needs of patients and physicians was indicated as an important aspect of understanding integration of electronic health information resources. Participants expressed value of quality of information to patient care as information is not secondary to care. While some respondents described activities and perceptions related to dimensions of information quality such as accuracy of information, others identified areas in which their primary care practices needed better information, and ways of making EMR data meaningful. This theme was used to capture such notions and the results are presented here. The theme extends discussions of the value of information to patient care, emphasizing differences between information and technology, as well as benefits and challenges of documenting information including information about determinants of health. This category identified statements related to quality of information input to regionally integrated EMR and aligns with data and information quality theme.

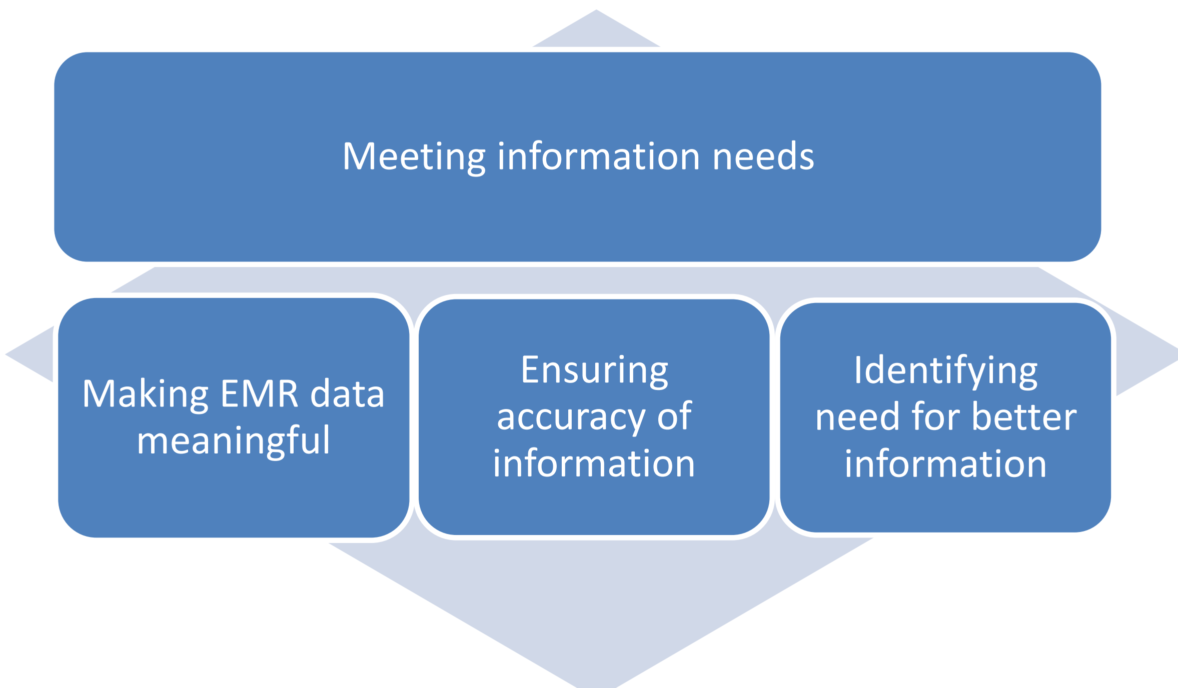

Figure 21. Emergent theme 'meeting information needs' and categories

6.3.6.1 Making EMR data meaningful

Respondents cautioned against seeing information as a secondary thing from care. Separating information from care is counter-productive because primary care physicians rely on information to deliver are: *"You need to know your source of truth, you need to know how good is the information" (PSWO3)*. This means the physician should know if the information that they have is current, valid and reliable. If there are bits and pieces of information that do not fit to the patient care process, they need to know how to access new information or modify their interpretation. In essence, to make EMR data meaningful, is important to view information as another element to the patient. For example, according to PSWO3, "*if a patient is told to follow-up with their family doctor in x days, we should have information in x minus one days*". Making EMR data meaningful is vital according to respondents, because the Canadian health system has reached a tipping point where a lot more data is electronic and there a several initiatives underway, so there is a great potential for getting data into something that is meaningful for patient and clinicians and having people act on that data by first making sure that they have the data they need to make decisions. Part of making information meaningful is to recognize that part of the reason for using EMR is to improve outcomes for patients by supporting providers and the care they are providing. Just because the technology is available doesn't mean that the information is available, and vice-versa, and just because technology is available doesn't mean that the information in it must be good. First, the data need to be recorded, and second, data need to be recorded in a way that allows that information to be extracted and used in meaningful ways. Using socio-economic information to illustrate this point, PSWO2 identified one of the challenges in the following quotation about patients' socio-economic status and its impact upon the quality of life, their longevity and how well they are going to live.

> *We don't document what people's incomes are. I will ask people how they do financially on their physical examinations. Not everybody does that, but I always ask, "how are you doing financially?". If they're not doing great, then I make suggestions in terms of how they can improve that. I think those things are really important and so I document that in their physical examinations. There's not a place where we say what did you earn this last year and just enter it in there. We don't do that. I think it's probably more of a social thing that somehow, it's offensive to talk about your financial status so that we typically don't. (PSWO2)*

.

6.3.6.2 Ensuring accuracy of information

Since clinical judgement and interpretation are dependent on information quality, the effect of that depends of physicians' access to accurate information. Respondents stated that some specialists can be late in recording information while, in general, if patients are seen at the hospital, information is usually quick and accurate. Everyone might have different information recording styles, yet the key is making sure that information is accurate and consistent across the system.

I would literally be in practice and order lab results in the morning, and it would be in my record when I'm seeing patients and the nurses would call me in, "Did you see this result?" and I'd already seen it 20 minutes earlier. So it works very, very well when it works. (PSWO8)

There is consensus across interviewees that advancement in lab information integration surpassed all other areas of information integration in the region. Physicians do have to ensure accurate information in areas where information availability, accuracy and integration were not quite as advanced. In some primary care practices, physician teams challenge each other to ensure timely and accurate information available in the EMR. For example, PSWO7 related how they organized a little competition about smoking information, challenging physicians to determine how many patients have up to date smoking information:

"Is there information as to, does your patient smoke, is he a smoker or nonsmoker? So, we had a little competition within each group. It goes on for six months. Okay, for the next six months we're going to keep track of recording it and at the end of six months whatever clinic has the most gets a pizza lunch. We won, so we had a pizza lunch because we had more indicated smoking status." (PSWO7)

For patients who are smokers, physicians can use that information to influence behavior change because if you can access the list of smokers in your clinic, then you can try to convince them to stop smoking. This is applicable to information about other aspects of clinical activities that can influence patient behavior change.

6.3.6.3 Identifying need for better information

Part of meeting information needs is identifying areas in need of better information and integration. Respondents indicated that medication integration would be critical. If physicians and patients had integration of full medication record in the electronic chart, that would be a huge leap forward, especially if lessons learned from integrating lab information gets transferred to medication information systems. Access to results was also indicated as a critical area in need of focus. For example, diagnostic imaging occurs outside of the hospital, so some primary care practices have to rely on that being faxed to the office and scanned into the charts. Similar situation for discharge summaries. If some other physician ordered a test, the family doctor may never see the results. It’s helpful to have records of other patient visits, but at the very least, if the primary physician can see what tests were ordered, what treatment, and what medications were started, it would be ideal for integration. PSWO12 illustrated this point with an example.

> *A patient of mine is currently in hospital in Woodstock, and every day I get his finger prick blood sugars that they're doing. They don't need to do finger prick blood sugars because he's on oral agents, and I don't recommend them being done anyway. I get that data, but I don't get a copy of the consultation of the*

> *physician who admitted the patient so that I know what's going on with that patient. It's better than it used to be, so sometimes it comes, but not always. What's really frustrating is that if discharge summaries are not done in a timely manner, then I have no idea what happened, and what the plan was when the patient was sent home. So more timely discharge summaries from institutions would be helpful. From the hospital in Stratford, we get a faxed copy of every emergency record of every patient that was seen there. We don't get anything from Woodstock hospital. (PSWO12)*

Several physicians in the region have drug seekers who come in and they don't know where they're getting other prescriptions from. The primary physician can provide prescription but don't know if patients are going to one of the walk-in clinics and getting another prescription. Even with emergency room visits, the family doctor may not know whether or not patients have been prescribed something from the emergency room. Despite efforts in public health arenas to cut down on narcotics and improve narcotics control, narcotics get into wrong hands. Respondents indicated that the EMR is probably the primary way to successfully tackle that kind of prescribing. "*I think they've talked about it but it hasn't been implemented yet in all practices, even looking across pharmacies, I think there's been some trial ones on narcotics but not ours unfortunately" (PSWO 14).*

> *Having some way to communicate with pharmacies or being able to access prescribing information, dispensing information from the pharmacies is probably the biggest gap that I think would be helpful to fill. We're still often in calling*

> *pharmacies to say, "When did this patient fill this medication? They seem to be out early." If we just had a way to look that up in our system, the patient got 10 pills on this day, it would save a lot of time of the pharmacists and us and it would really help our prescribing in terms of safe prescribing, appropriate prescribing. To me, that's the biggest piece that hasn't been integrated, is linking with the pharmacies (PSWO9).*

6.4 Emergent themes influencing perception of use

Six themes forming the basic components of emergent themes influencing the perception of EMR ***use*** are categorized as: EMR offering, EMR content, integration tool(s), data and information quality, patient characteristics, and physician characteristics. The main categories and subcategories are presented below.

6.4.1 EMR Offering

The EMR offering theme captured physicians' idea of an ideal EMR, how physicians decided on an EMR, and their experiences using specific EMR offerings available in their practices. Three categories were retained from the seventeen codes about EMR offering: the concept of *idealizing* emerged from analysis of participant responses on the question of an ideal EMR, the *deciding* category emerged in response to inquiries about how they decided to adopt or use an EMR, and the *specifying* category on specific EMRs such as Nightingale and Telus Practice Solutions which emerged in response to questions about experience of EMR use in transition as these two EMR offerings were in the process of merging at the time the interviews were conducted. The *specifying* category included information on OSCAR, Accuro and other EMRs that emerged in response to questions about typical experience using those specific EMRs.

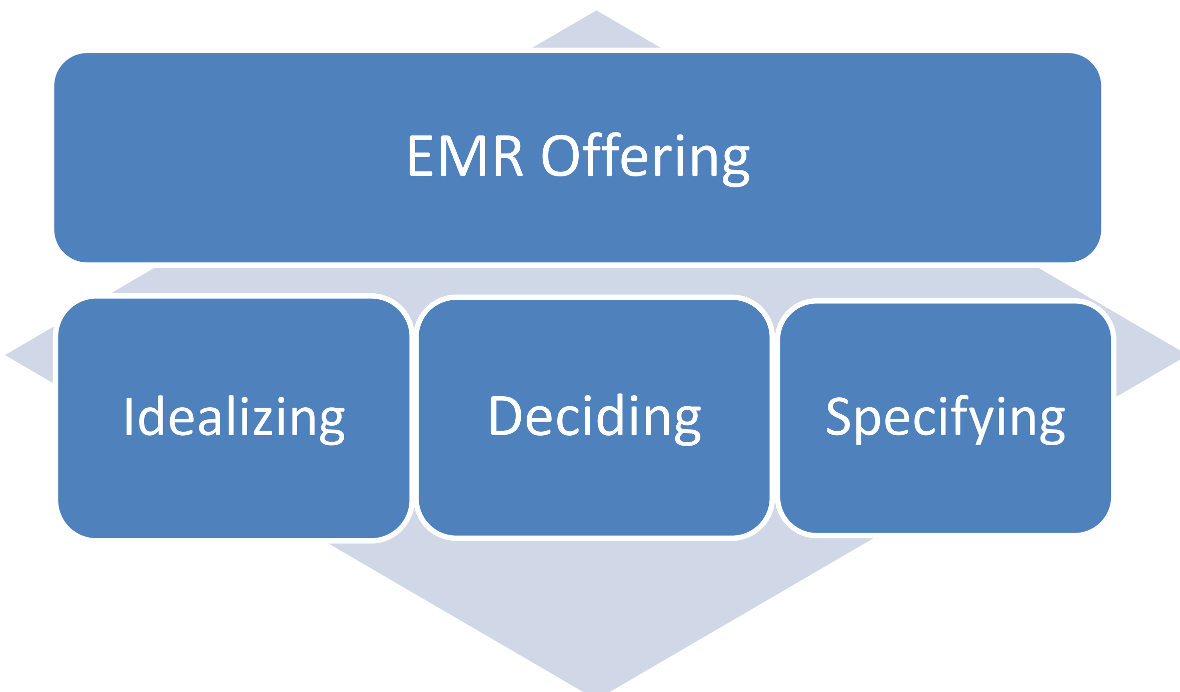

Figure 22. Emergent theme 'EMR offering' and sub-categories

6.4.1.1 Idealizing

The category “idealizing” captured interviewees’ descriptions of their ideas of an ideal EMR. Interviewees described the ideal EMR as one that *supports disparate workflows*:

> *“I want to see it be able to support my workflow the way I work. I want to see the end user interface mirror where technology is today”* (PSWO10).

> *“If I had opportunity to design EMR from scratch, that'd be really cool. But of course, I'm primary care and it would be difficult for me to envision what a surgeon or an internist would want*” (PSWO24).

The ideal EMR would allow the physician to “*dictate note instead of having to keyboard it*”(PSWO12), would “*probably be voice activated”* (PSWO18), would have “ *flexibility to have the end user adjust the user experience to match their personal workflow…and be able to mine the data in a way that can start to help us understand patterns of population based health in real time*” (PSWO10). In other words, while the physician sees a patient and enters information about the patient, artificial intelligence working in the background could provide additional information, compare similar patients, build and present further recommendations and predictions to help the physician determine best outcomes, medications, etc. Respondents opined that an ideal EMR would enhance capacity to collect and analyze population health data and perform real time analytics.

In primary health care, there are certain pieces of information that physicians typically want to see such as past medical history, current medication list, recent imaging results, and as a result the way that the information is presented to the doctor is of the utmost importance, "*but then it's also something that everyone feels differently about*" (PSWO24). So they would like context- specific data presentation and ability to provide multiple views for the user.

Respondents described the ideal EMR as one that would address limitations of current EMR offerings and provide seamless integration of patient data from all sources:

"*I think it would be ideal if all information related to our patient regardless if we ordered it or we're copied on it was available in our record, as well as community diagnostics*" (PSWO11).

"*I would be able to connect my clinic to the home care connection, because some of my patients are in the home, I have no idea what's happening with the nurses. I think it would be wonderful to also connect with hospitals and the medication is a big one for me. I think that's a huge deficit in Ontario*" (PSWO 13).

The ideal EMR would have "*e-prescriptions such that your prescription goes directly from your EMR to the pharmacy, so that means that there's a central database of prescribing, which would make things a lot easier for problems like opioid prescribing*" (PSWO15)

"*My ideal EMR includes integration between us and the pharmacy, where I can see everything that's been prescribed to my patients in the province*" (PSWO20).

To highlight the importance of sharing what the records show for patient medication, and for making medication reconciliation an easy process, PSWO 18 provided an example of challenges of cross-referencing medication information in current EMR offerings.

> *I would like an EMR that when I write a medicine down it always finds it instead of me having to remember something else. For instance, in this EMR, Atarax is only in as a syrup but Hydroxyzine, which is its generic name I can find it in the tablets but Atarax has tablets, so I've had to learn two languages anyway. It would been nice to have those cross references, to have to write those because supposedly ferrous fumarate is 300 milligrams but sometimes it comes up as 250, but there's no such thing as 250 in Canada or at least in Ontario. Having all of those little bits taken care of would be great. (PSWO18)*

In addition to ease of use, physicians described their ideal EMR as a system where the user could enter encounter information and keep that as an active medical record with a good medication list and vaccine profile through which patient information could be portable anywhere in the region: "*Hopefully one day even throughout Ontario and maybe even all through Canada, if you're visiting in Winnipeg or BC, why not be able to access your patient chart?"* (PSWO17); the ideal EMR would allow "any patient to access certain aspects of their medical record when they were in another hospital or emergency room" (PSWO12), "it would be much more seamless, it would get input from all sorts of different sources in an accurate kind of way, it would be protected and confidential"

(PSWO19), "it would be a system where I can see up-to-date hospital records and the hospital can see my records up-to-date. That seems like a no-brainer, to me" (PSWO20).

Other physicians related the idea of an ideal EMR to elements of regional integration tools such as portability with ClinicalConnect and interoperability between and among EMR offerings. For example, a system that allows the physician to input encounters and keep that as an active medical record with a good medication list or vaccine profile could be the perfect system if it could be made portable anywhere in the region (PSWO17): *"I hope we will be able to someday bring in the standards so that we'll be able to have a core set of data that you can just pull out of Accuro and plug into Practice Solutions. That will be the way that it will be one day"* (PSWO2). This is an area where organizations such as OntarioMD could take responsibility for and fund. An organization that provides funding would have the leverage to set parameters or have some conditions attached, such as ensuring EMRs are portability between practices.

> *If I sell my practice and the person who buys my practice says, "Oh, no. Accuro is too complicated for me. I want Practice Solutions." They should be able to take my practice, unplug it, and plug into Practice Solutions. (PSWO 2).*

6.4.1.2 Deciding

The category *deciding* captures physician descriptions of how they decided to adopt or use an EMR offering. Typically, *deciding* depended on purpose. For example, data ownership and security of information played an important role when deciding on an EMR. Both late and early career physicians offered unique perspectives on *deciding* with the former emphasizing support for change and the latter cost as main considerations. For newly minted family physicians in the region, cost considerations associated with *deciding* were two-fold: start-up cost and routine cost. For example, monthly cost was a factor in deciding as some respondents mentioned being incentivised when Telus Practice Solutions agreed to waive the startup cost. However, Telus required a contract… "*and we were nervous to be on a contract, because it was five years, and there's people in my practice who were thinking about retiring*" (PSWO21).

Several respondents decided on an EMR by assessing the various options that were available. For practices with hospital affiliations, the process often involved the usual request for proposal process designed to meet hospital or government policy or regulatory guidelines, as such, the EMR selected had to meet set criteria. There were very specific criteria for an EMR that was going to be used in a teaching practice, "*being able to use it with residents and other allied health*" (PSWO9). Typically, vendors proposed their products and how much the cost would be "s*o it was really more of a cost type thing for* *my current practice*" (PSWO11). In some ways, physicians who had to go through RFP processes to satisfy hospital or government requirements had less choice about the product because some family health teams mandate the use of the same EMR:

> "*Our family health team contract says everybody's gotta have the same one (EMR), so we have to abide by their processes as part of the trade-off of being their practice partner group*" (PSWO19).

Essentially, physicians involved in an RFP process had very minimal opportunity to have input other than in situations where they could attend top three vendors vendor presentations; this presented unique challenges if such practices were not hospital-affiliated or academic. For example, if an academic group decided to go with a different EMR, it would have huge implications for non-academic practices in the same call group: "*If we break our family health organization contract, that also has implications for our membership in our family health team, because there are a huge number of restrictions about that currently from the government's perspective*" (PSWO19), so there was a lot of uncertainty about *deciding* that had little to do solely with the quality of the electronic medical record product, but had huge implications for organization of physician practices and participation in primary care payment models in Ontario.

Physician personal preferences emerged as a factor in the *deciding* process: *"I know in practices where we used Accuro, it was also partially related to cost. It's cheaper than*

Practice Solutions. But those physicians really did not want to use Nightingale" (PSWO11). For physicians or practices willing to spend a little bit more, it was a bit of a balance between getting the features they were looking for, cost, and preferences. Further, for solo practitioners with no learners or practices outside of academic settings, the purpose of the EMR could be met without such considerations: *"The practice that I locumed for, absolutely Practice Solutions met the needs the best. I'm not sure how well Practice Solutions would work in an academic setting where residents are signing off notes to a faculty member every day*" (PSWO11).

Familiarity with family practice and personal relationships with developers sometimes factored in *deciding*, especially with EMRs developed by other physicians: *"We looked at a few EMRs, the one we have (chosen), was designed by a family physician, we liked the presentation that he gave. I had a personal relationship with that physician, which didn't hurt*" (PSWO12). The experience of transitioning also factored in the *deciding* process not only because of the need to change the EMR in such situations as when "*Nightingale got bought out, as a group here in the office, we decided that PS Suite would be the best option*"(PSWO17), but also because group practices needed to consider readiness of partners for change when practices move to new locations: "*We opted not to do that (i.e. adopt a new EMR), both because our partners weren't ready and it just would've been too overwhelming to both move and adopt a new system at the same time*"

(PSWO19). In other situations, physician practices explored available options by engaging directly with vendors before *deciding*: “We interviewed Oscar, Telus and Accuro, and we decided to go with Accuro, actually” (PSWO21), “we looked at it as a group and decided just in terms of, it was Canadian-based and they had a fair amount of experience with Family Practice, which was important to us, so mainly because of those two issues I think” (PSWO6).

Participation in special projects made the process of *deciding* on an EMR much more manageable for practices transitioning from paper to electronic records: “*We got involved with Healthscreen through Delphi Project, with Moira Stewart and her group, and that was really important actually in terms of getting people helping use the program and making the transition to electronic medical records*” (PSWO2). Healthscreen was a precursor to QHR Accuro.

Understandably, most new physicians who joined practices that already had an EMR were not involved in *deciding*: “*It's typically what was there. I wasn't the decision-maker in those cases. During my residency, there was a pretty great EMR that we used when I was resident, so I just used that one. That was OSCAR*” (PSOW1). “ *I'm not a part of the decision-making process around the EMR, it was here when I got here, no choice, those decisions were made before I got here as well. This EMR had been implemented since 1992”(*PSWO10).

To some extent, physician office managers and IT professionals participated in the deciding process: *"The decision was made on an administration level. Individual physicians didn't decide"* (PSWO23), "*our manager had done the initial look and sort of thought that there's a few that narrowed down the choices. Then we had a demonstration session of OSCAR and we all liked it. It wasn't my sole decision, but I was in agreement with going to OSCAR*" (PSWO22), "*we had IT experts from the hospital also helping us with that decision*." (PSWO15). Early exposure to multiple EMR offerings through training was also a contributing factor: "*We were ready to sign, and I had a thought, "Let me just take a peek at Telus. I'll do a download just to make sure I have done my due diligence." The trainer came and it was ... I was sold right then*" (PSWO20).

6.4.1.3 Specifying

The category *specifying* captures physicians' brief descriptions of experience with EMRs in current use. The top four EMRs used in the region (Nightingale and Telus Practice Solutions, OSCAR, Accuro) incorporate practice management and Electronic Medical Records systems designed for medical clinics and health care organizations. These EMR offerings typically include cumulative patient profile (CPP) and medical history, medication lists, progress notes, letters (referrals and consults), medical reports, lab tests, appointment, scheduling, intra-office communication, alerts/ reminders, and billing functions. At the time the interviews were conducted, two EMR offerings were in the process of merging, integrating, or being assimilated. Yet, several users were unaware of what the change would mean for them, how the change would impact their primary care practices, or what EMR they would be transitioning to:

> "*Nightingale's being phased out for the TELUS product, we'll be out of Nightingale within a year probably, but we don't know which product we're going to switch to at this point*". (PSWO9)

Some users described their EMR experience in terms of familiarity, challenges, and transition. Others extolled the merits of the EMR in their practices as indicated in the sample statements below.

> "*When I started out of residency, I thought I was going to use Nightingale because I was familiar with it. There were a lot of things I didn't like about it but it was something that I was most familiar with, so I felt comfortable using it*". (PSWO20)

> *"Practice Solutions I used only briefly, it is very expensive for clinics, but it was really powerful in terms of search, and graphically looks a bit nicer and cleaner, more modern let's say"(PSWO22)*.

> *If I was starting a practice and I was adopting an EMR, I'd actually go for Oscar, because it's free and it's easy. For somebody who might not be as technologically savvy, Oscar is amazing, it's not fancy by any means, but it give you what you need" (PSWO21).*

" I would say my clinic one, Accuro. I would say of all the systems that I use, it is the one that I like the best"(PSWO13), "we can document anything because Accuro is free-form documentation which we just type stuff in, it's the best of a bad bunch"(PSWO2).

6.4.2 EMR Content

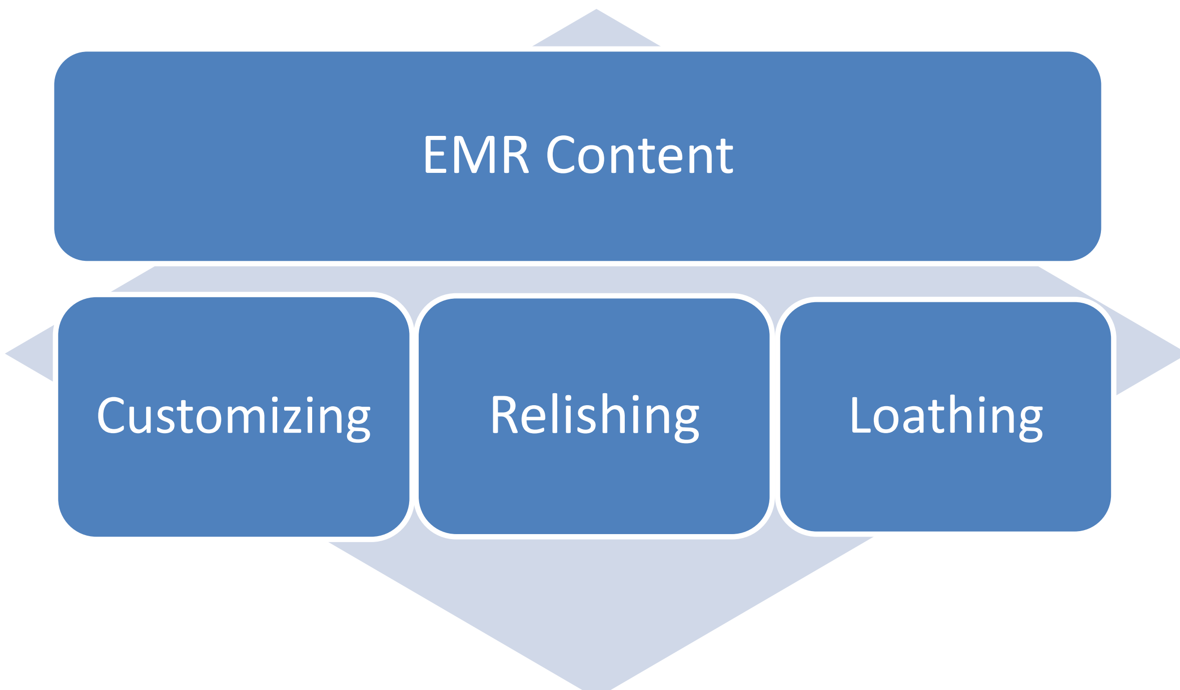

Figure 23. Emergent theme 'EMR content' and categories

6.4.2.1 Customizing

Physicians want information in intuitive formats hence the idea of *customizing* was highlighted in the interviews. For the purpose of this research, I define customizing as the ability to modify, adapt or tailor EMR content to user needs. Not having clear content standards leads some practices to use only structured data input or teach residents and staff to use structured fields and not do a lot of free text entry: "*It's made it a lot easier for us to be able to do some of the data mining because we have tried to be consistent with how we structure and enter our data"*(PSWO9). Some users have been using custom forms on encounter systems, more structured ways possible in the EMR to enter data and had some structured ways to enter things like diagnosis using tools developed at the region's e-Health Center of Excellence: " *So, we've developed some very easy to use, very quick tools that you can structure 100 diagnoses in the EMR"* (PSWO1). It saves time when physicians search for active medications and do not have to go to a separate screen to find inactive medications.

Part of customizing is the ability to generate lists of patients, described by PSWO24 as "*where the power of the EMR really comes in*". Depending on the EMR and purpose, respondents might use lists to determine and send notices to patients who need flu shots or to see who's due for a diabetic check; generate lists for preventative care for breast cancer screening, colon cancer screening, pap tests, etc.. Physicians use lists to capture who hasn’t been to the clinic in a certain period when they should be in to see doctor, or because they're taking one medication or another. Not every EMR allows users to easily generate or customize lists and not every physician can rely on generated lists: *“ I could generate lists, but I never trust that it is accurate*” (PSWO19), “*it doesn't always give you all the patients that are on a certain drug, because the drug can have multiple names* (PSWO13).

Some EMRs are not very user friendly enough to build a script for searches and queries and sometimes it can be a little bit technically challenging for physicians trying to construct queries properly (PSWO2, 10, 18, 22).

PSWO 13 described challenges with using lists as follows:

> *It's fine for the easy stuff that you always order, but if you're like me and you do palliative care, sometimes I'm ordering IV morphine and stuff like that, or I'm very strict on my narcotic patients and I'm looking to find a list of everybody. I've missed people. Benzodiazepines are perfect for that: So there's Valium, there's Ativan, there's Lorazepam, Oxazepam, there's like 10, 30 or 500 milligrams and I just want a list of patients that are on them, so I have to remember all the different ones to search for that. (PSWO13)*

It matters who is generating a list, and when and why lists are being generated. For example, a physician using medication lists to determine number of patients on opioids in a year needs to consider many different kinds of opioids and whether medication information was entered through the drug formulary or in free form:

> "*There's just no way for anybody to search to account for all of those kinds of variables because it's the variables in data entry that make retrieval so hard"* (PSWO19).

Data entry is not uniform from EMR to EMR, it isn't uniform from clinic to clinic, and it isn't uniform from physician to physician. In some situations, it isn't uniform even with a single physician: *"Sometimes I do it one way, sometimes I do it another way*" (PSWO19).

To mitigate against adverse impact of non-uniform data entry, some respondents use templates. Templates served not only to better organize data entry but also to keep physicians focused, especially for longer patient visits and older patients, a point made unequivocally by PSWO6:

> *When I first started the patients were young and fairly uncomplicated in terms of medical history, so it didn't take long to do their medical. Now the practice is older and because you are going through more detail with the patient, it takes longer to do so. I do think that having the templates, visit is better organized. It reminds you. It focuses you so that's why the visits take longer. I think even in a paper chart way it would have taken me longer. But to have a template that's loaded that's ... I mean I don't use a template for regular visits but every full check up I use a template and they're a huge help.* (PSWO6)

6.4.2.2 Relishing

Physicians *relished ease of use* and *ability to access information anywhere*. The fact that they could take a laptop anywhere in a clinic or hospital, sit down with the patient and while the patient is sitting there, make adjustments in their medication in real time, change orders in real time, look at lab data or patient X-rays, all in one place: *"I don't have to bring all that information together (myself)*" (PSWO10). When asked what respondents liked most about their EMR, responses ranged from ease of use, tidiness, to ubiquitous access.

> *"Very easy to see current problems, current medications, immunizations, adverse drug reactions are there, personal details are there. I love that." (PSWO12)*
>
> *I love the ability to have remote access." (PSWO13)*
>
> *"I think having things organized in a chart is helpful, not having a lot of clutter obviously with paper" (PSWO17)*
>
> *"That I can get the labs pretty easily. I can just move back and forth and do labs. That I can actually, I have access from my home to charts. Sometimes that's a good thing, that's a bad thing too. The good thing is, I don't have to finish everything here. I can go home, have my dinner and then go back to work without coming here. The bad thing is, I can take it on holidays with me. It's good and bad but it's probably better good."(PSWO18)*
>
> *I like that it's web based. It's a web-based solution, so you can log in anywhere, from any computer, so the access is very good. We don't have a server on-site, we*

> *don't have a backup of it that we're needing to take off-site for our records, that's all part of the solution that the companies provide. It's backed up in several places across the country, so we have little fear of losing our data even if the building burned down. That's probably the biggest advantage, is just that we know that we can get on it from anywhere. (PSWO9)*

> *"What I think I like most about Nightingale is that it's very easy to ... you can bring up a screen where it shows all of their visits. It shows the date, who saw them and the assessment code for it. You get a brief snapshot of what this patient has been coming in for on one page. I really like that feature about Nightingale." (PSWO11)*

> *"You can find things easier; you can find our labs and our consults a bit easier. So, that's what I would think the most about it" (PSWO21).*

> *The ability to do profile. The ability to do the prescriptions. If I was to print them all off and get them accurate and Nightingale is very good about that. The ability is very nice on Nightingale, so I like to do my own billing. I do have a billing overseer, but she has very little to do because we can do it so easily. (PSWO6)*

6.4.2.3 Loathing

Respondents also loathed difficulties or challenges of using the EMR, most prominent of which was the fact that several EMRs were not logically developed to suit physician daily needs or were based on legacy functionalities. Some respondents mentioned that EMR non-intuitive formats, obsolete or legacy functionalities sometimes led to working longer or after hours on finishing off charts, notes, putting in final diagnoses, doing the billing, etc. As expressed in the following statements, lack of intuitive formats, integration and user friendliness were prominent challenges to ease of EMR use.

"A lot of the technology is based on legacy functionality. It doesn't work the way you would expect something to work, it's just the front facing user interface is not very friendly. (PSWO10)

"By the end of the day, you'll have four or five tabs open for the EMR and it tends to be a little bit slow because of all the clicks to accomplish any task". (PSWO11)

"I think it's increased my administrative burden of chart maintenance." (PSWO19)

"The fact that I feel like it gets in the way of patient care, in a way, so, for instance if I was to talk to you but be writing notes, like you're doing right now. Versus if you were on the computer filling out a form, it would actually be a bit more distracting for us." (PSWO21)

"There's some redundancy in the software." (PSWO24)

"Everything you load just takes time, if you have to load five pages and they each take 30 seconds, that's a good chunk of the visit." (PSWO6)

"Many are not logically set up. They're not well supported. I'm talking about the IT support isn't good. You can't move from system to system seamlessly. There's a lot of data integration that doesn't go well if your system closes. The fact that systems are all very different and they can't talk to each other is a problem." (PSWO8)

"The time. Like I said, I see patients in a much slower way. I still have to finish this note that I saw a patient that we interrupted my interview to do this. I have to finish that note. It is going to take me another five minutes. In the past, I would have had it written down, we would have completed it and it would be done. I cannot make it any faster. I was telling people it was taking me double the time to see patients when I first started EMR. It's now about an extra 33% longer. I've gotten better but I will never be as fast as I was and efficient. I'll never be efficient as I was when I didn't have any EMR." (PSWO18)

"Along with that, one of the biggest disadvantages is you can get on it anywhere. You can take it on vacation with you. The disadvantage is really this particular product isn't that user friendly. It's not intuitive. It's kind of old now. The interface, it needs to be updated, and I think they were going to do that and then they got bought out by TELUS, so I think that's why they haven't, but it's not intuitive the way that a lot of apps work now, the way web browsers work. You're always looking for certain buttons or patterns, and it's just, it's different. It's not that intuitive to use."
(PSWO9)

6.4.3 Information Attributes (data and information quality)

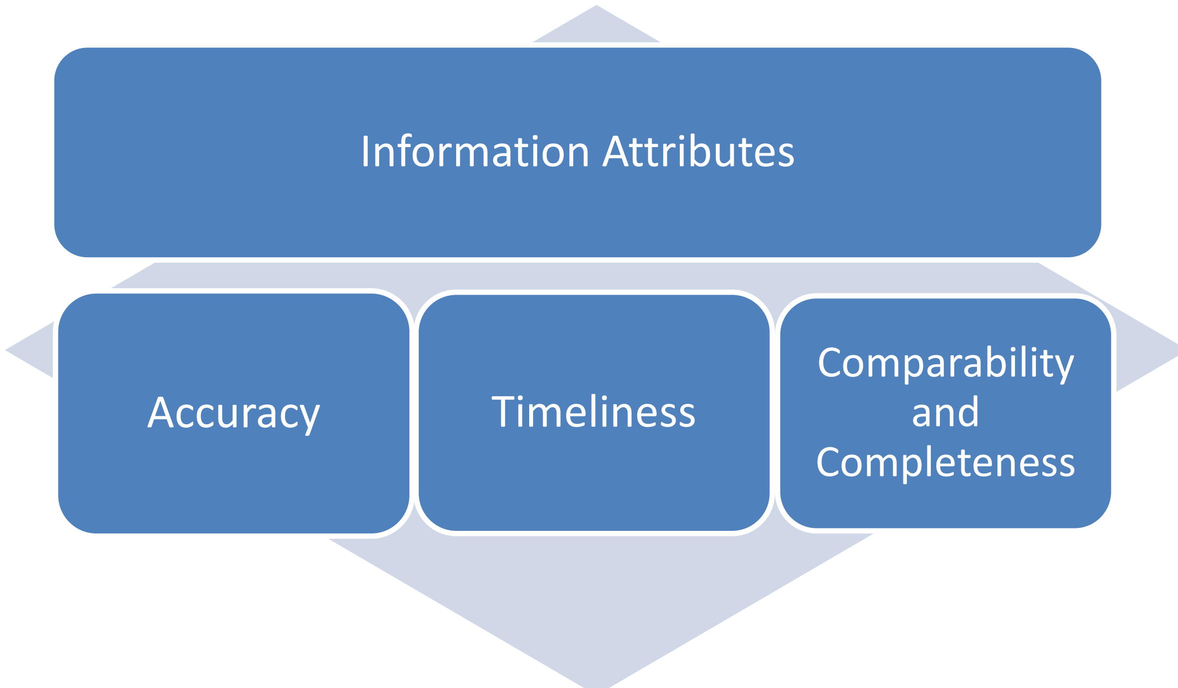

Figure 24. Emergent theme 'information attribute' and categories

Accuracy, timeliness, comparability, and completeness were recurring categories under data quality and information quality theme both in terms of participants' perception of EMR integration and in terms of participants' perception of EMR use. For example, participants generally agreed that not every EMR allowed users to easily generate lists or custom codes and among participants who do generate lists and custom codes on a regular basis, accuracy of information they relied on to generate those lists or codes were sometimes questionable because of differences in naming conventions, particularly for medication information.

Participants wanted information available in useable formats to enhance accuracy, timeliness and completeness of EMR data. EMR systems use a mixture standardized and non-standardized codes, but codes were often not mapped or logically set up taking up more user time, increasing chances of inaccuracy and incompleteness. “*The fact that systems are all very different and they can't talk to each other is a problem.” (PSWO8).* Interviewees generally stressed the value of receiving reports straight into the EMR from regional integration tools such as HRM and ClinicalConnect and that is related to completeness and timeliness. Lack of timeliness and completeness sometimes result from family physicians not receiving preliminary notes containing important information pertinent to patient care from the hospitals or when specialists fall behind in completing notes. Likewise, information from emergency departments with little electronic documentation is rampant in the southwest region. Physicians do get faxed copies of reports that might already be available through HRM or other regional integration tools, potentially leading to duplication of records. Several physicians in the region complained about lack of EMR integration with pharmacy systems as some cannot ascertain how their patients fulfilled prescriptions or whether some patients received prescriptions from emergency departments or walk-in clinics.

Lack of integration has a consequent impact on accuracy, timeliness, and completeness of patient medication information in particular, which undermines physicians’ ability to use such information for patient care.

6.4.4 Practice Type/Context

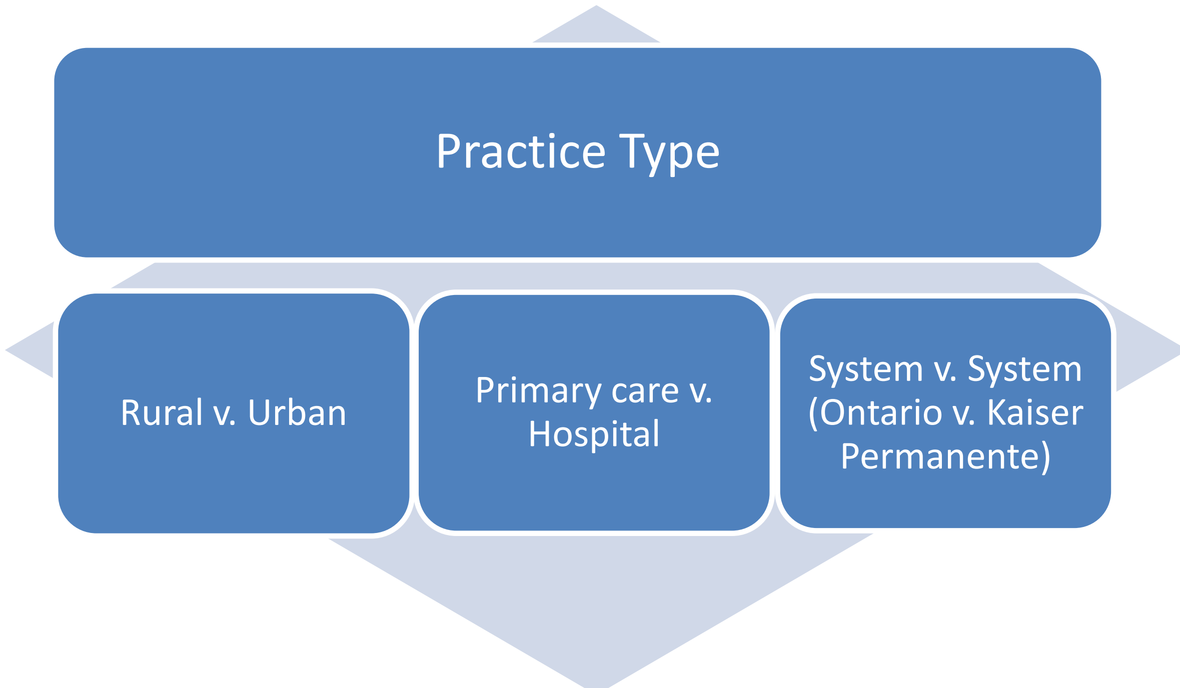

Figure 25. Emergent theme 'practice type' and categories

Primary care practices are very similar, yet very different. Different doctors will bond differently with different patients. For example, practices that have distinct mental health populations function differently from practices that have distinctly high immigrant populations. A physician with an interest in developmental disabilities might attract a large number of patients with developmental disabilities and dedicate more practice time, tools, and resources to developmental disabilities. Practice context changes for patients and physicians after EMR implementation, sometimes affecting how the EMR is used.

> *There are many physicians who love and have a point and click box system where it helps them remember the questions that they want to ask and it's just a very simple procedure. We're all so different and yet we have to have a common EMR. We can't make it work for everyone the way everyone wants it to work. (PSWO18)*

Respondents made comparisons by practice level, revealing that the experience of integrated EMR use varies by practice context in the region. Differences exist sometimes within the same practice. For example, PSWO13, a primary care physician with hospital privileges working in a rural setting decried the lack of integrated progress notes, despite progress made connecting hospitals with primary care practices, the experience with access to hospital information is different if the practice context is rural rather than urban, and if the physician has hospital privileges rather than working only in the community, as the following example suggests.

> *There's been a huge issue with documents from assessments for pacemakers, breast screening programs. Hospitals in Owen Sound and Walkerton, now Hanover, instead of actually dictating a note that says "normal breast exam", they say, "please, see report in images", which of course, is not in our computer system, it's in the hospital computer system. So every time there's a breast screening, that's what the radiologist does, and then they just scan the paper into their chart, which of course, we don't get the paper copy .so basically, the*

> *technician takes that one they've scanned and then sends all of us those paper copies, and then we scan them into our system because their scanned images can't be transferred from their systems to our systems. It's ludicrous when they do that, it's so frustrating. You can't send that as a report. There are family doctors who don't have privileges in hospitals. (PSWO13)*

Participants further made practice context comparisons at the health system level. Several interviewees compared Ontario's approach to EMR integration with the American integrated managed care consortium, Kaiser Permanente, stating that Kaiser have, essentially, a regional operation, serve a patient population base of about nine million, roughly equivalent to the population of Ontario, adopted a single integrated EMR, have an IT department that is devoted to managing the information system, dedicated large funding to change management, and that their health insurance payment systems in the United States are very different and required a lot more information in a different kind of way than Ontario's system does.

> *Integration is system dependent. The province made a mistake in 2005. It should've taken Kaiser Permanente's lead and bought one system for hospitals and one for doctors' offices. That was their mistake. Has to do with our model of decision making and health in Ontario. Kaiser Permanente is the same size of healthcare system as Ontario. They have one EMR, it integrates perfectly. So all Ontario had to do is to say all the hospitals use this, we batch bought it. All the clinics use this, and then it would be seamless. But instead, because they've had so many versions of so many systems, McKesson was a lot in Southwestern*

Ontario have left, you've been left with a whole group of people who can't talk to each other electronically. That's the problem. (PSWO8)

If you look at some successful projects, Kaiser prominently, you may know them in the States, they spent four billion dollars on their electronic health record, half of that, two billion dollars was change management. So, it really speaks to the fact that, you know yes, we can get these great tools, but we need to make them work for clinicians and for patients. And that's the biggest fail point. (PSWO1)

6.4.5 Patient Characteristics

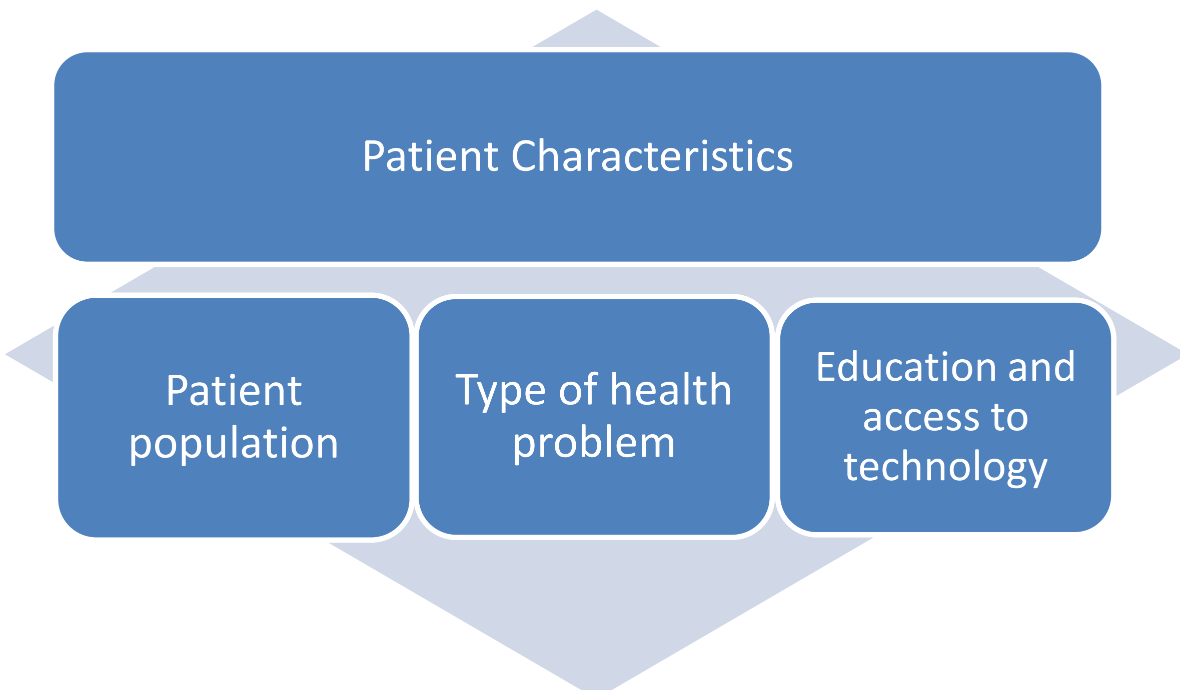

Figure 26. Emergent theme 'patient characteristic' and categories

In addition to practice context, characteristics of patients emerged as an influencing consideration on physician's description of integrated EMR use. Participants described patient population in the region as varied, cradle to grave, covering all age and income ranges. Depending on age, interest, savviness with information technology, and considerations such as cost, patients' use of electronic information system varies.

Some patients love technology while other patients may feel overwhelmed by it or may not be in the right position to adequately understand and engage due to health problems. Tools like patient portals are valuable for people who are well educated about their health problems and/or patients who are familiar with and used to what parameters they are looking for in results or reports. For example, a well-educated diabetic knows what their hemoglobin A1C should be, say, seven or under, and they may love to see their lab results before the physician sees the results because they already know the feedback if they're engaged in their care. A patient who can't distinguish between a clinically significant abnormality from a non-clinically significant abnormality in test results may become stimulated to become better educated and more discerning about their medical care and how to interpret clinical reports and test results. By the same token, if the patient is the kind of person who gets anxious about test results, then it could be a bigger problem checking online or through portals because they become really anxious about the need to make decisions about what ailment they may or may not have based on something which, for the most part, may be clinically insignificant or about which the physician may not care much.

> *Lots of people have very minor things, for example, with their white blood cell count, but I don't care about, and I'm never gonna care about, 'cause it's never gonna make them sick. And it's not a part of illness. There are some things that are important, when I look at results and there are lots of things that may be a little bit abnormal but aren't important. So, that too is an education process. (PSWO19)*

Part of being a physician in the southwestern Ontario region, particularly in group practice, was that every day some practices assigned physicians to patients with no advanced bookings, meaning physicians were open to all urgent problems of the practice for that day, and may even see patients of other physicians of the group. This provided participants with a unique opportunity to characterize some patients in relation to EMR use and patient access to electronic health information resources. In situations where an easy-to-use electronic health information resource is introduced, participants described patients as being more engaged:

> *And it's interesting I found, and some of my colleagues have found that patients will be more truthful to the tablet sometimes than they are with their own provider. I've had patients who have*

> *told the tablet they're suicidal, and I'm not sure they would have told me in some instances. (Respondent 11)*

One of the challenges highlighted by participants was the diversity of experience with people and using electronic systems. For example, one clinic implemented a system that sends diabetic questionnaires to patients on their smartphones which they were expected to fill out and send back to the clinic to help the physician prepare for the patient visit. "*My 27 year old patient could do that, my 89 year old patient who still has a black dial phone, not gonna do that" (PSWO19).* Older members of the population who require more medical care, who were not brought up on a smartphone often find pushing buttons intimidating, "*they feel it devalues their personal connection*" (PSWO19).

Several respondents criticized the lack of patient portal connectivity to the EMR. There were a few patient portals and some of them were linked to an EMR such as the KindredPHR that linked to OSCAR EMR. Other patient portals link up to OSCAR EMR as well. "*Telus Practice solutions had a portal but no longer has one. We used it seven years ago, and had good success with diabetic patients, them entering their data and them seeing sort of their record, it was a good initial start*" (PSWO1). Users of transitioning EMRs such as Nightingale mentioned that although the older EMR had a patient portal module, they didn't use patient portals with their patients because it would ultimately depend on what new EMR they eventually switched to.

The way current patient portals are set up contributes to lack of use among patients, who for the most part, may not be aware of their existence or how to use them in the first place. Typically, there are different levels or tiers to what patients can do. They can use portals to schedule appointments, to look at results, perform secure messaging with doctor's office, and perform some online transactions like paying for services provided. Participants opined that EMR use was moving in the direction of patient portals and certainly lots of practices already have patient portals with features that let patients have access to some information. Even with labs, companies such as LifeLabs and Dynacare connect through portals that allow patients to access their own labs online. Respondents stressed that there were benefits and drawbacks because on one hand it is important for patients to have information, or access to their own health information but on the other hand, patients' unique characteristics could lead some to worry about results or book unnecessary clinic visits in order to interpret the values they see in reports. "*They see something marked as abnormal when to me it's just a normal variation" (PSWO11).*

Participants further described patient characteristics as an important consideration given that some physicians see patients with psychiatric or anxiety problems. Respondents with large patient populations with anxiety and psychiatric disorders stated that giving such patients access to a portal or an electronic module where they can actually log-in and book an appointment was a bad idea.

> *I talked to my partners with psychiatric patients, and sometimes with these people he had to place a restriction on them saying you can only see me once per month because they don't actually have a physical problem. What they're dealing with is anxiety, if he let them, they would be in here every day, twice a day, so he says "no!", he doesn't want to have that type of patient portal. (PSWO2)*

Potentially, patient portals linked to ClinicalConnect through the e-referral project would allow patients to access their wait time data, to understand what the wait times are, and what the status of their referral may be when it is booked or triaged, or allow patients to book their own appointments.

> *We're just in the process of delivering a new patient portal through ClinicalConnect called My Chart. That's a product that Sunnybrook developed in house, Sunnybrook in Toronto developed a patient portal. If you go to Sunnybrook, you will get a little password to go into My Chart, which is a patient portal. We're actually building that into ClinicalConnect so that you'll be able to,*

> *as a patient, go into your ClinicalConnect and see all of your data the same way your doctor would be able to. (PSWO10)*

Patients may not use the portals because some EMR vendors provide free basic access and charge patients additional fees for more advanced features. Moreover, participants serving an older demographic described such patients as not being keen on using portals.

> *Maybe if you ask the younger doctors who have younger patients, but my patients are not really computer wizards or computer literate and I don't think they need it anyway. Doctors had it and it sounded great initially but patients stopped using it or didn't use it or there was a cost involved so patients had to start paying for it. When you have to pay, patients don't want to do that. (PSWO7)*

For physicians, clinical implementation of patient care plans differs from clinical implementation of electronic health information tools to engage patients. Participants familiar with patients asking for their own information stated that current patients aren't particularly different from the past, but physician approaches to responding to information requests by patients differs from tht prior to implementation of EMRs. It has become easier to satisfy patient information requests post-EMR because physicians can print off information in a second whereas before they had to find it, get to the photocopier and put it in. "*I think it just looks better. If they want to know* *their allergy print out I can give it to them or they want to know their labs, it's easier to do that way." (PSWO6)*

6.4.6 Physician Characteristics

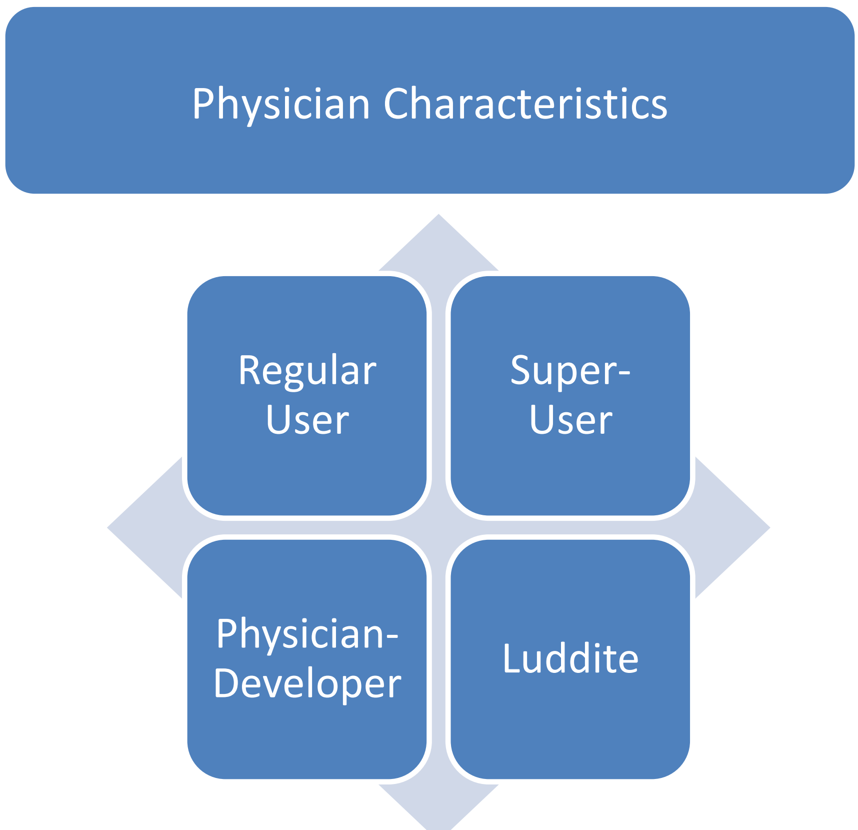

Figure 27. Emergent theme 'physician characteristic' and categories

Analyses of participants' responses helped the researcher to identify participants' responses that reflected physician characteristics in relation to EMR use. Generally, physicians were seen as slow to adopt, implement or use electronic medical records or other forms of information and communications technologies. Although the EMR was generally available to physicians during the course of this research, physicians' unique personal characteristics appeared to play a major role regarding who was more likely to actively use the EMR in their practice, and the extent of EMR use. Four types of users were identified in this study: the regular user, the super-user, the physician-developer, and the luddite.

Most participants exhibited characteristics typical of regular EMR users, while others self-described as superusers. The regular users engaged in basic use of the EMR for routine, day to day activities related to patient care. Superusers typically worked within primary health care teams, often served as liaison between developers and clinical teams, were more proficient in EMR use than regular users, and often provided technical support to other clinicians. The physician-developer combined the roles of primary care physician and builder/developer or creator of EMR software and related applications. In some instances, the physician-developer wrote software codes, scripts, or programmed the system to improve efficiency of EMR use. The luddite is averse to EMR use and resists changes to accustomed ways of doing clinical work that may accompany EMR use. The luddite prefers old ways of doing things such as using paper records.

> *We had one doctor who absolutely refused to use a computer. When we moved to a new clinic, we had to design one room which is reserved for seeing patients, but just to put their charts there so they could continue (to work). You have to accommodate all that. It's lovely to see this colleague, they were a good physician. The change was not easy, but they're now doing it [i.e., using EMR]. They see the benefit of it, that it's mostly the benefit of being able to be part of a team. (PSWO16)*

Regardless of physicians' unique, personal characteristics, the importance of continuous learning was not lost on most of our respondents, as emphasized in the following statement.

> *Well, I suppose as I get older and have now pulled away from doing some common things, I am going to need to be able to learn how to learn. Again, our current learners learn in a different way than how I learned. I need to embrace the technology that helps me keep up or at least lets me look back at something, because for 30 years I've just done what my memory has told me, and it's been a really good memory. If I couldn't remember something, I'd remember the patient, I'd go into their chart and I could find it (Self-described luddite respondent).*

6.5 Typical daily EMR use: Before, during and after patient visits

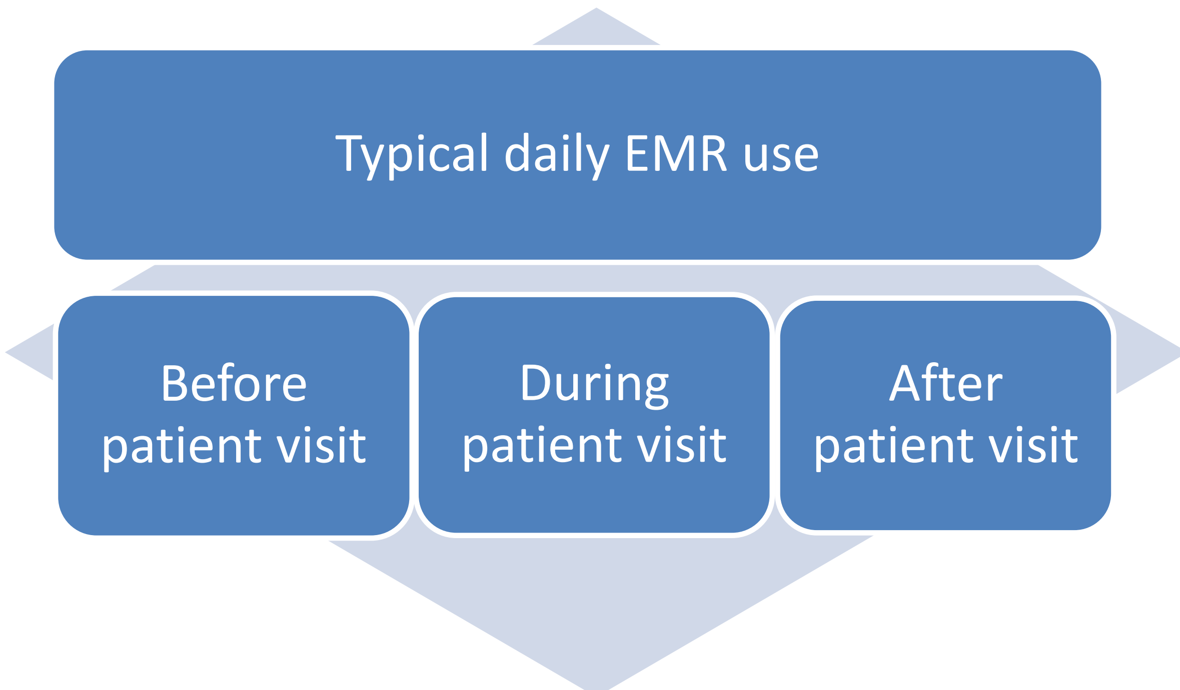

Figure 28. Typical daily EMR use

For most interviewees, the physician's entire day is contingent on the EMR, not only because all of the patient's information is on EMR, but also because the physician schedule is also on the EMR. Physicians typically use the EMR to prepare for patient visits by reviewing the patient charts, often use the EMR during the patient visit to take notes and review the chart to inform and reassure patients during visits, and complete notes and billings associated with the visit after the patient leaves. Respondent 21 described the process as follows.

> *Before the patient comes in, I would use the EMR to review their chart. While the patient's there in the room, I will type some notes, maybe if they mention something in their past, I might go through the EMR to look for it. Then, I'll type some reminder notes, etc. If they're in the room and they need a consultation, I'll do the consultation in front of them, because I think first of all, if there's any extra questions I might think of but also that I know it's done, so I just feel like there's a bit of reassurance. If they need any medication or lab reports or anything like that, that I'll order while they're there in the EMR. Once they've left the room then I come back, and I complete the note, and then I would do any billing associated with it, through the EMR as well (PSWO 21).*

Experienced physicians' familiarity with patients was described as an impetus to use EMR in preparing for an appointment. Respondent 1 stated that the EMR was helpful in making sure that physicians "*proactively look at the [patient's] information to make the visit meaningful*" (PSWO1), and using tools such as "*templates to pull information into current notes ensures all information could be viewed at a glance*" (PSWO1). Preparing for an appointment, respondents typically review lab tests, diagnostic imaging tests and previous encounters to look over and make sure there's not anything new, and to understand reason for patient visit. For example, if the patients were on medication, how often they're using the medication, last time a prescription was made or if they are diabetic, to look at what happened previously. Practices that have fully transitioned from paper-based record perform similar activities preparing for a patient visit as those that have not fully transitioned. Most of the activities involved review of the patient records. For Respondent 23, " *most of the information if it's coming from the outside, it won't be uploaded in the medical record system we have here, but there is a paper chart still because we haven't completely transitioned over to electronic stuff*" (PSWO23). A fully transitioned electronic record system often incorporates pre-set templates: "*I use pre-set templates when I see my patients. When they come in, I just push on the template that I want to use. If it's a physical, then I use a physical template. If it's just for a regular visit, then I'll use a SOAP template*" (PSWO4).

Respondents extolled the merits of the fully transitioned electronic record system over paper-based records. Despite the fact that nurses and clinic staff at the frontlines use innovative tools integrated with the EMR (e.g., tablets), and assist physician interaction with and focus on the patient's problem prior to seeing the patient, having nurses and clinic staff use the EMR often meant multiple log-ins for privacy and security of patient information. Physicians in practices where a nurse or clinic staff logs in to open a background screen while the physicians logs in to the integrated EMR main screen to access patient information described time efficiency that allowed the physician to access a fair amount of information available related to the specific patient visit prior to seeing the patient; "I know the vitals are in, why the patient is in, et cetera, so when I walk into the room, I tip it [the screen] onto the patient and the information is basically there" (PSWO6). The EMR "shows me my patients for the day, sometimes I'll look at my daily patients, because they have a tab that just shows your day patients and have a tab for your week of patients, it's great (PSWO13). "I usually carry a tablet and I can have pretty much all of my patients' information available to me on the tablet or a laptop" (PSWO4). Certain EMRs come with different layers of access privilege such that when bookings were made, there will be information about the problem, blood pressure, for example. The next person to access and use the computer could be the nurse who looked at their section, which may be vital signs or the nursing history. The admin staff version might include information about reason for patient visit along with associated nursing or admin information. Such layers of access allowed nurses and clinic staff to engage with patients prior to seeing the physician as described by Respondent 9 in relation to use of mobile devices:

> *What we also do in our clinic is we use tablets. For certain patients, and my staff are well aware of this, when they come in, they get a tablet. [For example] If they have depression, and we're looking after them, they will fill out the questionnaire on that tablet. That tablet integrates right into my EMR, so that will also give me the data. Before I even see them, I've got that data and when I see them, I've got that questionnaire filled out. It helps me sort of direct where I need to focus on them. I'm not asking them the routine questions; I'm diving into areas where there are problems (PSWO9).*

In primary care, most physicians know their patients for several years, sometimes from cradle to grave, and a lot of the time they know why they're at the clinic, and where they're at in their health story. Though certain physicians use the EMR to prepare in-between visits, the impact of access to information in the EMR, to do a quick glance at the patient record prior to the patient visit has been generally positive for most interviewees, and as one physician put it, "*I have not found that it negatively impacts the quality of my visit in the least"* (PSWO20). Essentially, for most interviewed physicians, the first thing they did prior to seeing the patient was to have time set aside to go through the dashboard/record, go through any incoming labs, any incoming imaging reports, open up the patient file, their cumulative profile with their problem list, and medications, and allergies, past history or last encounter. While some physicians prepared for specific patients they would be seeing, others would go through the process for all patients across the board. In some situations, physicians did not necessarily do a lot of prep work on their chart beforehand partly because some patients don't show up or they cancel or postpone, In a general sense, EMRs have evolved to allow physicians to be proactive and more prepared for patient visits because they can look at patient information as it comes in during the patient encounter, not only before the patient comes in. When in the consultation room with the patient, the physician takes notes in the patient file while maintaining patient interaction.

EMR use during the patient visit was contingent on the type of visit. For a straightforward medical type visit, the physician may type notes as they talk to the patient. Impressions of patients varied when physicians used an EMR during patient visits:

> *“Occasionally patients will say, "You know, we felt like this resident, or you or whoever, was paying more attention to the computer than us," which is a risk” (PSWO9). “It's a real art, though, trying to type and talk and listen and look here, there, here, there, it's an art to be able to do that” (PSWO17). In general, patients are more familiar with physicians typing during the visit. “My particular practice, they've had electronic medical record for seven or eight years so patients are pretty used to it” (PSWO11). “I think for the most part they like it. They appreciate it. When you're reminding them of a couple things they weren't even thinking about, generally they're happy that you're thinking about it”*. *(PSWO17)*

In some cases, physicians reported patient complaints about divided attention between the patient and the computer. “*I've been accused of not paying attention to the patient because I look at the keyboard instead of at their face when they're talking*” (PSWO12). *“Some older patients maybe do not like it quite as much. Or with the learners, they may spend a little bit more time looking at the screen rather than the patient and certainly, there have been a few patient complaints in that setting”* (PSWO11). “*They hate it. They hate it if you're typing while you're talking to them and patients complain about that all* *the time*" (PSWO13).

Physicians used the layout of the consultation room to enhance interaction: *"One of the reasons our screens are set up as they are is so that when I am reviewing your information, if you choose you can see it… we can review information together on a screen"* (PSWO19).

Some use other strategies to mitigate against the impact of divided attention between the patient and the computer. Using dictation rather than typing was identified as a way of ensuring undivided attention to the patient as stated by PSWO13: "*I don't type, that's why I dictate*" (PSWO13). "*I can type fairly quickly. I can type faster than I can write and so it's been fine. My partner uses Dragon Dictate. He's not as good at typing, so he likes to dictate his notes, but I just type them up while I'm sitting there with the patient"*(PSWO2).

Others divide their time between talking to the patient and interacting with the EMR:

> *"I try not to stare at the screen the whole time. I'll look at them, get some conversation with them. Maybe while they're talking, I'll start typing and looking back and forth. It's just a matter of finding that" (PSWO17).*
> *"I have asked them, and people have not found it really a problem. They laugh at me because they hear how hard I type, so we make a joke about me" (PSWO18).*
> *"I ask them questions, enter the answers to those sometimes. Then I examine them. Then I sit down and I briefly enter my findings"(PSWO12).*

PSWO12 further described how they typically mitigate against the impact of divided attention on the impression of the patient while using the EMR during patient visit. Physicians typically recognized the importance of documentation and the need to finish patient visit notes as soon as possible. However, if it's a note that was for a mental health reason or it was a complex visit for which the note could not be completed during patient visit, physicians complete the note later: *"Generally, I do it right at the time. It partly has to do with typing speed, too"* (PSWO20). If the physician's not adept at 'typing' then they may use a dictation software or do it another time. Some physicians fit in all note taking during patient visit.

EMR use after patient visits generally involved completing notes from previous patient visits and preparing for the next patient visit:

> *Part of my note usually is left unfinished because I spend a lot more time talking at the end just in terms of our plan. Once they leave, usually my notes are marked unfinished. I can go to my office here, just in the back, finish typing my note, maybe takes an extra minute, minute and a half. Then I can go to see the next patient. (PSWO12)*

One of the perks of using EMR for documentation is ability to review uncompleted patient notes after the visit when the physician isn't as pressed for time as when patients are in the waiting or consultation room.

6.6 Chapter summary

The results presented in this chapter form the basis for the development of a robust comprehensive model of physician integrated EMR use. This chapter provided deeper insights into key issues related to physician use of EMR within the context of regional integration in southwest Ontario, mainly from semi-structured interviews which covered a broad range of issues pertinent to EMR use. The use of participant quotations is justifiable not only because it is consistent with grounded theory but also because it illustrates one of the most definite ways to capture primary health care physicians' experiences as they expressed their use of and perception of the impact of EMR. The results presented reflect different perspectives emphasizing the importance of information as an essential component of patient care and the patient encounter, the crucial role technology plays as an enabler of better care in improving doctor-patient communication, and the challenges of a fragmented electronic health information system. This chapter is crucial to a thorough portrayal of physicians' experiences in the region. The next chapter presents the discussion of findings from all phases of this research and how the results align with EMR literature to provide answers to the research questions explored in this thesis.

Chapter 7

7 Discussion

This chapter presents and discusses results related to findings from the quantitative analysis, and qualitative analysis, including maturity model association tests. The discussion of results presented here also address the main research questions contextualized and situated within existing literature.

7.1 Perceptions on regional integration of EMR

Perception of electronic medical records in the context of regional integration appeared to be shaped by the need to facilitate care coordination and communication in real time, partly because the purpose of the patient record has shifted in recent years as we move into the electronic record from a paper-based tool mainly used to assist physicians in the care of patients to a more comprehensive purpose involving information and knowledge sharing, performance measurement, teaching and learning. This is consistent with findings from previous research which identified EMRs as enablers of within-office care coordination (O'Malley et al., 2010). It is critical to recognize that the existing and potential capabilities of an integrated EMR in a regional landscape provide new opportunities to enhance care coordination not only through basic EMR use, but also by enabling efficiencies in scheduling, communication among clinicians and patients, encounter documentation management, referral and consultation, among others. This requires policies and programs targeting the regional integration of EMRs. In an article published in *Healthcare Policy*, Terry et al. (2016) identified a trio of multifaceted policy and research agendas comprising a need for research, harnessing the knowledge of primary health care EMR stakeholders, and policy actions. They identified areas with most gaps in knowledge and research including the value of EMRs, EMR implementation and adoption, data element definition, data entry and extraction procedures, data sharing, an all-encompassing framework for interoperability and ideal EMR design.

Consensus existed among participants that paper-based medical records had several limitations such as missing information stemming from illegibility of notes, unorganized or inaccessible documentation that often makes it difficult to guarantee quality of patient care. Participants in this study indicated that everyday use of the EMR improved documentation, tracking and legibility of notes, and using regional integration tools such as HRM enabled a more secure receipt of reports from participating sending facilities, to which they otherwise would not have access. Even though physician perspectives were shaped by typical daily use of the regionally integrated EMR, several respondents described experience of EMR use before, during and after patient visits in ways consistent with previous research on benefits of EMR in primary care.

Findings from this research further suggest that the experience of EMR use is shaped by change, not only in terms of technology such as EMR tools and offerings, but also by changes to physician workflow. As shown in the core categories that emerged as a theme to identify responses indicating that even though participants may have previously used EMR or may have been practicing in primary care for a long time, the experience of EMR transitioning imposes need for adjustments to how they work. This study showed that EMR transitioning is not comparable to nor does it represent a minor upgrade burden on the part of users. While the full extent of EMR transitioning is not known, it is important to note that several respondents were still undergoing transitions (e.g., from Nightingale to Telus Practice Solutions) during the course of the study. Many participants may have delayed assessment of impact of transition until after a new EMR is up and running. Respondents generally did not indicate having a transition plan and many may have uncertainty about the impact of transition on workflow and everyday practice, only recognizing the magnitude of such impact while the transition was already in progress.

Perception of primary care physicians about EMR use was equally shaped by the need to manage patient expectations. This research identified physicians' attitudes towards patients' access to their own health information. The confluence of patient characteristics and physician characteristics in the context of EMR use is an important consideration because while some primary health care physicians see themselves as sole custodians of patient health information, others feel patients should be at the center of integration of their health information (from all sources). In order to deliver the best patient care, it is important to view information in the EMR and other sources as an extension of the patient. Findings indicate a need for EMR integration features that enhance patient-physician interaction. Patient portals and other features that allow shared access to electronic health information could reduce the burden of long-distance consultation and care giving not only for regular patient visits but also during catastrophic events such as a pandemic. Meeting patient expectations would require improved communication among multiple care providers, paying careful attention to measurable risks to data security, and addressing challenges with reconciliation of information from multiple physician-patient information sources.

Engaging regional entities emerged as a pertinent theme describing physicians' experiences of using regional integration tools such as ClinicalConnect, and captured descriptions of physician experiences of engaging with organizations implementing integration tools (e.g., cSWO), as well as nuances of working in primary care *vis-a-vis* connecting with hospitals, pharmacies, and walk-in-clinics. Regional programs with the aim of providing both technical and non-technical assistance to support EMR use need to anticipate disparate barriers to effective or mature EMR use and give priority to primary health care providers. For example, Alexander et al. (2017) described a cSWO Benefits Model using case studies to examine how physicians enhance their ability to generate clinical value for patients when introducing new information into clinical workflow, and how clinical care teams use such introduction of new information to enhance their capacity to generate organizational value. The model involved assessing progression of deployment of tools vis a vis clinical workflow, and examined benefits originating from change management and adoption, best practice research and a combination of data analysis and best practice research. While this model addressed the relevant points that a user might perceive as important in improving care delivery, it failed to address benefits from a regional integration perspective and focused more on adoption rather than use of health information resources. The model investigated assumptions about how care providers accessed information and the influence of information on making new decisions or altering already made decisions in order to improve patient outcomes. Findings from and contribution of this thesis would complement the application of existing models such as the cSWO Benefits Model, providing another avenue to explore engagement with regional entities such as cSWO.

Findings on perceptions of impact and benefit were consistent and comparable with previous research. For example, Anderson (2007) found that physicians largely perceive benefits of information technology along with barriers to implementation in their practices such as lack of access to capital, complexity of information systems, and lack of standards for health information exchange. By providing incentives for health information technology use, practitioners could be encouraged to actively overcome barriers related to certification and standardization of vendor offerings, security of medical information, and ease of clinical data exchange (Anderson, 2007b). Larger health institutions and hospitals in urban areas like London and Hamilton were more likely to have financial resources and easier access to new technologies than primary care institutions. They also tend to have more processes in place for health information technology change management. Fewer support sources exist for primary care physicians.

EMR use is perceived differently among urban and rural practices, and among primary care physicians with hospital privileges and those without hospital privileges. Examining EMR experiences of primary care physicians in community, urban, hospital and academic family medicine, Ludwick, Manca and Doucette (2010) explored how the physician care environment impacted on implementation of EMRs. Though their research focused more on adoption rather than EMR use, the researchers found that physicians in community settings typically lack access to resources related to interdisciplinary care coordination, technical support, and EMR training than those in urban, hospital and academic settings could easily access from working in larger interdisciplinary teams (Ludwick et al., 2010). Practices in urban, hospital and academic settings do participate in better organized EMR system implementation programs compared to community physicians who had to transition on their own without adequate support for training, in-house technical support or planned system rollout. The researchers concluded that rather than using renumeration to facilitate EMR adoption (and by extension EMR use), building stronger professional connections, more robust training and in-house technical support should be the focus of effort to encourage more primary health care physicians in community settings to adopt and use EMRs.

Essentially, the experience of integrated EMR use varies by practice context. Findings from this research suggest that primary health care physicians with hospital privileges described more advanced integrated EMR use compared to primary care physicians who only worked in the community, without hospital privileges. Some physicians compared the condition of EMR integration with areas based on comparable population sizes or the use of a single, integrated medical record system versus multiple systems. A culture of regional engagement that fosters collaboration and provides support to primary care physicians in multiple environments and settings would create a favorable environment necessary to enhance mature EMR use.

Physician perspectives are influenced by initiatives to examine the benefits of an EMR. In a study by PriceWaterhourseCoopers (2015) on EMR benefits realization in Ontario, maturity of EMR use was defined as "the level of adoption and functional use of the EMR in the practice setting" (p.22). This definition conflates adoption and use by describing EMR use in the context of EMR adoption (PricewaterhouseCoopers, 2015) even though a clear majority of primary health care physicians do use an EMR on a regular basis. Maturity of EMR viewed from the lens of EMR adoption undermines the soundness of analyses of EMR use, hence the need to refocus attention on use beyond adoption, something I achieved through this thesis. The study by PriceWaterhourseCoopers (2015) on EMR benefits realization in Ontario, further identified four key benefits dimensions; quality of care; communication, coordination and access to care; efficiency; and patient experience. The study found that EMR use resulted in improved evidence-based decision making at the point of care, functionality within EMRs such as report generation, search tools and auto-population tools enhanced support for chronic disease management, health promotion, screening and prevention (PricewaterhouseCoopers, 2015). While the report acknowledged that greater interoperability and integration among EMRs and provincial electronic health information assets could enhance maturity of EMR use and comprehensiveness of patient records, it recommended continued effort to advance EMR maturity through tools and knowledge that enable providers to maximize EMR use. This thesis is a major contribution towards realizing such recommendations.

Regional integration of the EMR is often impacted by availability of support including support to cover costs of acquiring and maintaining an EMR, especially for new physicians who may not have received funding to adopt an EMR. Differences exist in funding support for physicians across Canada because not all provinces offered financial incentives to physicians; among those that did, financial incentives only covered about

70 % of eligible costs, and often set time limits to availability of funding (Chang & Gupta, 2015). For example, while Alberta provided support to individual physicians of up to $50,000, Ontario provided a maximum of $29,899 per physician, comprising $3,500 in a readiness grant, $2,000 in a performance grant and $675 per month for 36 months (Chang & Gupta, 2015, p. 1080). In this thesis research, I found that physicians' perspective on support for everyday EMR use goes beyond technical support from EMR vendors or support for EMR training at the practice level, it includes support received through programs by professional organizations such as OntarioMD (e.g., Insights4Care, Peer leadership program, EMR certification program, etc.), including programs to support accurate billing through EMR use that assist family physicians to correctly code and capture primary care services consistent with OHIP billing codes and fee schedule (Larsen, 2015, 2019; OntarioMD, n.d.-a, 2004, 2015; Webster, 2011b, 2011a, 2013; Yeung et al., 2013). Among EMR users who participated in this study, 74% of our respondents indicated that they received funding or financial incentives to *adopt* an EMR while most (81%) reported not receiving any funding or financial incentives to *maintain* their EMR. Some respondents estimated the cost to maintain an EMR per month could run from between $1,500 per physician to over $4,000 per practice (depending on the type, size and location of the practice). Only 19% reported receiving funding or financial incentives to maintain their EMR, some of which were the result of community support that rural communities provided to keep primary care practices running.

Analysis of physicians' viewpoints in this thesis revealed that EMR data quality is a prerequisite to better patient care, indicating that physicians placed value on timeliness, completeness, accuracy, and reliability of EMR data. Poor data quality undermines the potential value of clinical reports to and from regional integration tools designed to facilitate patient care because it may be impossible to know if poor data quality, such as missing clinical data reflects failure of EMR users to comprehensively perform their duties of patient care or simply a failure to properly use the EMR to document, store or transmit what they have done. While regional integration tools such as HRM allows clinicians to receive reports and follow-up with patients, patient information only gets sent from HRM to clinicians' EMRs, not vice-versa, which may contribute to poor data quality. Since both patients and physician practices often move and change locations, multi-directional data flow that ensures complete, accurate, timely, and reliable data transfer is necessary to assure data quality. The regionally integrated EMR presents a great opportunity for secondary use of good quality data, not only for clinical care and research, but also for health planning, healthcare policy, and health management purposes, locally, regionally, nationally, and internationally.

7.2 Typical use of regionally integrated EMR in primary health care practices

The study findings illustrate that there is no such thing as a typical use of regionally integrated EMR. Physician, patient and visit characteristics may facilitate or hinder regionally integrated EMR use, and primary care and family physicians in the region take greater advantage of basic use features of the EMR before, during and after patient visits. This research indicates that patients do request health information and often bring their own health information during visits, with the expectation of that data being integrated with clinician EMR data. Patients who brought their own information appeared to have significantly higher education and were more computer literate than those who did not bring information during visits. This finding suggests that interventions to enhance integration of patient-held records could result in better communication and interaction among patients and caregivers. The finding further suggests a possibility of a significant educational gradient in health information technology use patterns among patients in the southwestern Ontario region. Increased patient involvement in care is an established and well-known method of improving health outcomes but has rarely been studied within the context of regional integration of EMR use. The use of regionally integrated patient portals may be one way to assess patient involvement in care and encourage patients to access health information, and for physicians, to improve typical use of EMR or move up the maturity level beyond routine, basic use.

As shown in the results chapter, physicians prepared for patient visits by viewing and assigning tasks and often used the patient charts as a starting point. Physicians reported greater benefits of EMR use with patients, especially for simple and routine issues such as ordering and viewing regular laboratory tests results. This suggests that the EMR can be deployed in ways that improve physician and clinical staff attitudes towards using the EMR not only as a means of recording patient encounters, but also as a means of communication with patients. Despite its promise, using an integrated EMR as a tool to engage with patients comes with unique challenges because patients may resist using patient portals if they perceive the EMR as an intermediary between them and their physicians. Moreover, limitations inherent in the features of EMR offerings may reduce the appeal of using technology over traditional face-to-face interaction among patients and primary care physicians. EMR features such as the CPP (used to keep the record of a patient's relevant medical history) and the Encounter (used to capture information about the specific patient visit) need to be complemented by features that assist users to communicate more effectively.

Katz, Nissan and Moyer (2004) found that physicians and patients vary regarding their preferences for modes of communications. While physicians appeared to prefer means of communications based on complexity and sensitivity of the patient problem, patients preferred online communication over visits regardless of complexity or sensitivity of health problems (Katz et al., 2004). The notion that some patients were "being truthful to the tablet" in some situations than to their family physician and therefore seemed more at ease in providing detailed and reliable information about their health was an interesting finding from this research in alignment with previous research (reference). Researchers found that electronic communication encouraged patients to ask questions they might not feel comfortable asking in person or on the telephone (Jeske et al., 2001). Respondents tended to feel strongly that availability of the right technology for patients provided primary care practices with benefits that they could not have obtained from the EMR alone. This idea was described in the context of patients using tablets to answer questionnaires in the clinic, prior to seeing the doctor that helped direct the physician to areas where the patient needed most attention, rather than merely using technology to ask patients routine or basic questions.

The work associated with patient visits was done by physicians in many different ways. This research illustrates that EMR use often involved liaisons and conversations with colleagues and trainees, or conversations with nursing staff and clinical assistance staff. For example, observed physicians often checked with colleagues in the process of completing the CPP, medical history and follow-up notes, orders for tests, test orders sent electronically, lab results, patient demographics, and imaging results. Physicians and their colleagues considered as ‘super users’ often had the additional responsibility of creating and maintaining practice specific templates to help enter subjective/objective clinical findings or mandatory fields much more easily. Physicians helped each other to lighten significant workload when tasks such as messages from patients, basic interpretation of parts of test results, basic questions and requests from nursing homes or referrals could be triaged or handled by other members of the clinical team.

7.3 Factors influencing use of regionally integrated EMR

This study revealed seven main factors influencing perception of use of a regionally integrated EMR, namely physician characteristics, patient characteristics, integration tool(s), EMR content, EMR offering, data and information quality, and practice type.

Physician characteristics were identified as an important factor from analysis of findings from this research. Demographically, 43% of respondents identified as female and 57% identified as male. Analysis of differences using Wilcoxon-Mann-Whitney test revealed that none of the stage variables showed a significant association with sex of physician (at 0.05 significance level). It implies that both male and female primary care physicians experience regionally integrated EMR use equally in the southwest region of Ontario. This finding is not completely surprising as the gap between female and male physicians in Canada has been narrowing in recent years and no evidence currently exists to suggest that male physicians are any more or less technologically savvy or technologically literate than female physicians, and vice-versa. According to the Canadian Institute for Health Information (2019), between 2014 and 2018, the number of female physicians increased by 21.1% whereas the number of male physicians increased by 7.0%, and in 2018, 46.6% of family medicine physicians and 37.7% of specialists identified as female. Interestingly though our group of non-users were identified as predominantly male, reflecting age and years in practice rather than a sex-based difference in technology use.

CIHI estimated that the average age of family physicians in Canada is 50.1 years old and 51.1 years old in Ontario (Canadian Institute for Health Information, 2019). The majority of our respondents were between the ages of 45 and 65 years which suggests that older physicians constitute a high percentage of primary care and family medicine physicians practicing in southwestern Ontario. The implication of having more older physicians working in the region is significant. On one hand, older physicians have garnered deeper knowledge, experience and skills about caring for the patient population that may be difficult to replace as they near retirement. On the other hand, early career physicians taking over from retiring physicians may be faced with the additional responsibility of having to integrate patient records which may still be in paper form into the EMR. To ensure continuity of patient care given the challenges that can be associated with patient follow-up, physicians' unique personal characteristics would come into play regarding who is more likely to actively use an EMR in their practice to effectively address the challenges of continuity of care. Four types of EMR users were identified in this study: the luddite, the regular user, the super-user and the physician-developer.

Despite increasing use of EMR in the region, adoption is not 100% as only 86% of physicians use an EMR. Characteristics of EMR users differed from those of non-users. It is reasonable to expect a reduction in the number of the 14% who reported not using an EMR provided the reasons for not using EMR are adequately addressed. For example, among the 14% of respondents who identified as non-EMR users, 87% identified as male and only 13% identified as female, none of those who identified as non-EMR users were under the age of 45. In addition to demographic characteristics such as physician age and sex, we examined association between stages one to six of the maturity model and physician location of practice, number of years in primary health care practice, length of time a physician has had an EMR and how physicians rated EMR in their practices. Results showed significant association at 0.05 significance level (via Kruskal-Wallis) between stages one, two and three of the maturity model and how physicians rated the EMR in use currently in their practices. This suggests that the basic use, basic use plus and practice improvement levels at which physicians were using their EMR influenced how physicians perceived and rated their EMR as excellent, very good, good, fair or poor. Higher stages of the model related to integration with regional and provincial tools, performance and quality improvement features, and patient/community resource linkages did not show strong association with physicians' rating of the EMR. As expected, association test results showed that the number of years physicians spent in primary health care practice is a highly predictive factor of the number of years physicians have had an EMR in the practice. This suggests that despite the fact that newer physicians may have enhanced skills and ability to use an EMR in particular and new technologies in general, longer serving physicians typically have had longer exposure to EMRs as they have entered Canadian medical practice over the last twenty years, even if some of them were not as exposed to other new information technologies as their younger counterparts.

Patient characteristic was identified as an important factor from analysis of results of this research. While I recognize that physicians' opinions should never replace patients' views, interviewing patients was out of scope for this research. As expressed in the rationale for the study, my thesis focused on physicians as proxy for understanding patients and patient care, and as trained professionals ultimately responsible for the care of their patients. Numerous physicians described their patient population in the context of integrated EMR use. Patients' characteristics varied by location, age group, sex, education level, and type of ailment. Patient characteristics also varied by patients' ability to access and effectively use technology. Physicians who described their experience with patients asking for their own information mentioned that the EMR has enhanced their ability to respond effectively to such requests as it has become much easier to access information from the EMR and make it available to patients in print or other forms.

Several respondents decried the fact that patient portals were not being used to the fullest capacities, partly because patients lacked awareness of the potential to use portals to schedule appointments or view test results. Research examining the impressions of clinical administrators, clinic staff, and health care providers on patient portals found that despite recognition of the potential benefits of patient portals, uptake of patient portals was very low because portals were perceived to introduce new work and confusion, discouraging health care providers from embracing portals (Miller et al., 2016). While Miller et. al. (2016) did not seek the opinions of patients and primarily focused on a disadvantaged population, the study failed to adequately address the impact of the digital divide or educational disadvantage that might lead to low uptake of patient portals in disadvantaged populations. In a similar study, Perzynski et al. (2017) found that a major factor associated with access to patient portals was residence in neighborhoods where most homes had broadband internet. Most elderly and minority patients were less likely to reside in such areas (Perzynski et al., 2017). Despite finding low expectations for immediate use and higher expectations for future use, Miller et. al. (2016) identified potential benefits of patient portals such as improved access to health information for both patients and caregivers, greater patient satisfaction, enhanced information sharing and improved clinic front office efficiency through reduced volume of phone calls for prescription results and lab test results. Other research identified lack of technical support and fear of erosion of personal relationships between patients and care givers as two of the main barriers to portal use (Lyles et al., 2016). For portals to be effective and reach their full potential of enabling better health care, clinicians, health care administrators, health policy makers, and patients need to view them not only as a technology that adds value, but also one that could serve as a bridge to assist vulnerable populations to cross the digital divide, reduce health inequalities, and improve health of individuals and populations.

Integration tool(s) was/were identified as an important factor in perceptions of use (and integration). Three main integration tools examined were Hospital Report Manager (HRM), Ontario Laboratory Information System (OLIS), and ClinicalConnect. Integration tools and features of such tools figured prominently in participants' discussion of the EMR though there was no consensus on whether a single point of integration (e.g., ClinicalConnect) is more effective than multiple points of integration (e.g., OLIS, HRM). If the patient is placed at the center of integration, the risk to privacy, security and system failure may be minimized, provided the patient is fortified with the necessary tools and technical know-how, and is in good mental, physical, emotional position to receive, process, interpret, understand and manage health information. Integration efforts need to be directed both locally and regionally since the majority of patients who stand to benefit do not often change locations beyond the region to access care.

OLIS as an integration tool has been practice changing for most physicians because it allowed physicians to not only access lab reports and related information, but also follow up with patients after discharge. Ensuring that labs are not repeated leads to improved clinical outcomes and enhanced clinical value because it helps close the loop on missing lab data and reduce costs of repeat, unnecessary tests. OLIS was described as beneficial and useful because information comes in as a graphable kind of discrete data, so physicians can compare to previously available information. Hospital Report Manager (HRM) as an integration tool directly pulls reports from hospitals into physicians' EMRs leading to time savings. ClinicalConnect as an integration tool allowed access to consult notes, lab information, drug repository, hospital discharge summaries, and a host of other information. Since much of the information provided by Hospital Report Manager and Ontario Lab Information System could also be served through ClinicalConnect, "integration of the integration tools" is an endeavor worthy of exploration to keep reports and tests together for easy access. Findings from this thesis research corroborates other studies about integration tools (Chami et al., 2017; Eapen & Chapman, 2015; Larsen, 2015). For example, Eapen and Chapman (2015) found that clinicians considered improvements in quality of care as an overarching benefit of bringing data from disparate sources to the point of care with perceived potential for enabling improved patient care.

Regardless of perceived strengths of each of the integration tools examined, physicians appeared more enthusiastic about using OLIS (so much so that it forms part of the basic use of the EMR), compared to ClinicalConnect and Hospital Report Manager. The majority of participants (86%) either agreed (38%) or strongly agreed (48%) when asked whether they received lab test results through OLIS in the EMR, compared to only 28%

of respondents who strongly agreed and 12% who agreed with the statement about routine use of HRM to retrieve details of patients' recent hospital visits, and only 42% who either strongly agreed or agreed that they routinely used ClinicalConnect.

Despite being touted as an integration tool developed and used in the southwest Ontario region, participants decried the extent to which ClinicalConnect was integrated with EMR for three main reasons. First, at the time of this research, physicians working in the community and those without hospital privileges could not launch ClinicalConnect from patient charts within the EMR. For example, if a physician is working in the patient chart, with contextual launch the physician can have access to the patient's record directly from the chart, rather than indirectly through a web portal requiring an additional log in. Users mentioned that because the tool usually took them away from the EMR, it posed a challenge to ease of use when they had to log in to a different system. Second, its federated model of information retrieval often resulted in slow performance and low reliability because information is sourced from non-integrated, disparate sources, with inconsistent retrieval rapidity impacting on timeliness of the information accessible to physicians. The federated model of retrieval is a decentralized model of health information exchange that differs from a single, data warehousing model (McCarthy et al., 2014). Data remains at the information source, allowing health care providers to manage and control their own patient information. Participation requires agreement on the part of the data owner or custodian to allow other organizations to access their data (McCarthy et al., 2014). Third, differences in roll out across the region left reluctant adopters and skeptics less enthusiastic about the usefulness and benefits of ClinicalConnect. Physicians in practices where the majority of the patient population was served using information resources available locally in the community did not appear to use ClinicalConnect as frequently as those serving patient populations coming from various other parts of the region.

EMR content was identified as an important factor from analysis of all phases of this research (observership and shadowing, questionnaire, and interview phases). OntarioMD (2015) established the core EMR specification that defined both functional and nonfunctional requirements for an EMR offering in Ontario, focusing on component, functionality or interoperability, and comprised of main baseline requirements and requirements for data portability and data sharing (OntarioMD, 2015). Discrete data requirement for EMR content includes patient information (demographics, address, alternate contact, family history), provider information, ongoing health condition, past medical and surgical history, immunizations, medications, lab test results, allergies and adverse reactions, risk factors, alerts and special needs, reports received , appointments and care elements (OntarioMD, 2015). In addition to non-functional requirements (data management, auditing and logging, implementation support, licensing and privacy), the discrete data elements constitute the building blocks of the functional requirements comprised of management of the Cumulative Patient Profile, workflow, billing, demographic, reporting query and communication, encounter documentation, lab test, medication and immunization, system access and interface requirements, scheduling, external document management, referral and general EMR management (OntarioMD, 2015).

A high percentage of respondents (92%) used the EMR for billing and scheduling. This is a significant finding for two reasons. First, current EMRs evolved from electronic health records with relational or hierarchical databases added to hospital billing and scheduling systems, and maintained on large mainframe computers or removable disks, before information systems allowed physicians to directly enter orders, prescriptions or notes (Evans, 2016). The high number of physicians using the EMR for billing and scheduling suggests that such early, legacy functionalities and features are still relevant and important today. Second, it raises fresh questions about whether billing and related regulatory requirements are driving clinical documentation and whether there is tension between using the EMR to meet medical versus financial goals.

Most physicians used the EMR to prescribe medications and generally agreed with the statement on EMR use for prescribing medications, 78% strongly agreed while 16% agreed with the statement, and only 6% chose either strongly disagree (2%) or disagree

(4%). While this percentage appears high, it is important to note that these responses only indicate that prescriptions were not being written directly on paper. Despite ubiquitous use of EMR for prescribing, EMR systems and most pharmacy systems do not communicate, most prescriptions printed from EMRs had to be manually re-entered into pharmacy systems (Institute for Safe Medication Practices Canada, 2018). Other than transcription errors, the Institute for Safe Medication Practices, ISMP Canada (2018) identified the impact of poorly integrated information systems for prescription as the unintended introduction of risk to the prescription process including prescription modifications missed by the system, loss of prescription bundling, confusing free-text entries, and reduced patient engagement. In a 2013 joint statement, the Canadian Medical Association and Canadian Pharmacist Association defined electronic prescribing or e-prescribing as "the secure electronic creation and transmission of a prescription between an authorized prescriber and a patient's pharmacy of choice, using clinical electronic medical record (EMR) and pharmacy management software" (p.1). Pharmacy information integration has been a challenge in Canada (Barnett & Jennings, 2009; Canadian Medical Association & Canadian Pharmacists Association, 2013). Canada Health Infoway launched a national service in select communities in Alberta, Ontario, and New Brunswick called PrescribeIT with two core functions (prescriptions and prescription renewals) that allows physicians to send prescriptions to patients' preferred pharmacy (Canada Health Infoway, 2019; Rothbauer, 2020). If implemented correctly, the Institute for Safe Medication Practices, ISMP Canada (2018) identified potential advantages of PrescribeIT to include medication safety benefits such as enhanced prescription communication, support for better medication adherence, better patient engagement, and support for medication safety strategies such as for opioid use. To highlight the importance of e-prescribing and EMR integration with pharmacy systems, respondents described an ideal EMR as one that addressed limitations of current EMR offerings as expressed succinctly by PSWO20: "*My ideal EMR includes integration between us and the pharmacy, where I can see everything that's been prescribed to my patients in the province*".

Several respondents kept medication lists and generally agreed on the use of the EMR to easily generate lists of lab test results. Ability to generate lists gave users the leverage to customize EMR content to determine the number of patients who might need preventative services such as Pap tests, colon or breast cancer screening, or patients who might be due for regular checkups, need flu shots or be due for diabetic check. However, accuracy, timeliness, and completeness of generated lists were not always guaranteed. Research indicate that failure to accurately keep medication lists up to date can lead to duplication of therapies and drug-to-drug interaction and problem lists generated in electronic health records tend to be inaccurate, duplicative, and out of date (Devarakonda et al., 2017; Monte et al., 2015). Respondents explained that physicians had to account for several variables when generating lists because data input and types of variables in the EMR render data retrieval difficult. Physicians largely agreed that the EMR provides tools to record the current patient problem(s) and keep a CPP. Yet, most CPPs allowed users access only to active medication lists, suggesting that even within the same EMR, integration can be lackluster. Rather than relying on the physician to manually generate lists, EMRs need to be equipped with features to automate list generation through machine learning and natural language processing. Moreover, EMRs need to be user friendly in assisting physicians to easily develop scripts for searches and queries.

EMR offering was identified as an important factor from analysis of all phases of this research (observership and shadowing, questionnaire, and interview phases). The top four EMRs used in the region (Nightingale and Telus Practice Solutions, OSCAR, Accuro) incorporate practice management and Electronic Medical Records systems designed for medical clinics and health care organizations used by several physicians in the region (Canadian Healthcare Technology, 2016; Chan, 2018; Newswire, 2013; Nightingale Informatix Corporation, n.d.; QHR Technologies, 2019; Telus Health, 2019). These EMR offerings typically include patient profile and medical history, progress notes, letters, medical reports, lab tests, appointment, scheduling, intra-office communication, reminder, and billing functions. At the time the research was conducted, two EMR offerings were in the process of merging (Canadian Healthcare Technology, 2016) though several users were unaware of what the change would mean for them, how the change would impact on their primary care practices, or what EMR they would be transitioning to. Several studies on the EMR examined adoption and implementation, yet in-depth analysis of EMR transitioning and its impact are necessary to shed light on this little known but clearly increasingly important aspect of EMR use. EMR migration is an important area of research in need of serious attention because most EMR users have transitioned beyond moving from paper-based records to electronic records, to migrating from one EMR to another EMR. In a guide for community care practices, OntarioMD (2017) described EMR transitioning in the context of EMR migration and data migration as “the process of switching from an existing EMR system to a new EMR system” (p.4) which may be as a result of the current EMR no longer meeting user needs, changing practices to one that uses a certified EMR, or EMR vendor consolidation with another EMR vendor (such as the Nightingale/Telus PS merger). Not all EMR migrations involve data migration. Although the OntarioMD EMR migration document outlined key milestones and timelines for an EMR migration in a four stage process involving planning, vendor selection, implementation and go-live, and post-go-live support (OntarioMD, 2017), the document did not include a comprehensive guide or training guide on how primary care physicians could create, implement, and review a successful risk management plan given that most migrations do not always go smoothly, and the ensuing impact on physician workflow could be enormous. Some of our respondents contemplated closing their practices in the event that EMR transitioning failed.

In spite of perceived challenges with EMR offerings in current use, participants' perception of an ideal EMR revolved around customizability and clinical workflow efficiency. In addition to ease of use, respondents identified portability and interoperability with integration tools (ClinicalConnect, OLIS, HRM and others) as key features of their idealized EMR. An ideal EMR is not the same as real EMR. Primary care practices use the baseline requirements guide developed by OntarioMD to help select a new EMR. The guide advises practices to create a selection team that would work as a group to investigate, assess, and select the EMR (OntarioMD, 2015). Participants described considerations that go into deciding on an EMR such as cost, availability of support for change management or formal processes such as formal requests for proposals. Familiarity with developers sometimes factored in the process of EMR selection especially with EMRs developed by other physicians, which is suggestive of the importance of inter-personal relationships in the EMR selection processes.

Unlike previous research which suggested that completeness and accuracy of EMR data in primary care mainly depended on the enthusiasm of family practitioners (Majeed et al., 2008), my thesis research findings firmly establish the centrality of EMR integration to accuracy, timeliness, comparability, and completeness of EMR data and information. I contend that proper integration of regional electronic health information resources within the EMR in doctors' offices could accelerate the pace of creation of standards for reporting data quality in primary care and extend the limits of EMR data quality measurements in regional settings. When asked whether data accessed through the regional integration tool ClinicalConnect were always timely, accurate, and complete, only 30% of respondents either agreed or strongly agreed. Such a low percentage is not reflective of lack of enthusiasm on the part of family practitioners, rather, it is an indication that it is not enough to integrate the container without ensuring quality of the contents and provides an opportunity to approach regional integration of the EMR with renewed focus on the importance of data and information quality.

Practice type was identified as an important factor in use and impact in this research. Practice type was analyzed from a variety of perspectives reflective of the context within which the practice was observed. For example, 20.7% of our questionnaire respondents worked in physician office solo practice, 29.30% worked in physician office, group practice, and 32.8% work in family health teams, suggestive of potential variations in access to support for integrated EMR use since a solo practitioner might not have access to the same kind of EMR use support system as a physician working in group practice or family health teams, where users could tap into the collegial resources from superusers or physician-developers. In addition to working in primary care, some respondents had hospital privileges or worked in Community Health Centers with technical, logistical and financial support for EMR use that may not be available to solo community practices. Moreover, association test results revealed a statistical association between location of practice operationalized by Local Health Integration Network and Stages 4 and 6 of the maturity models at 0.05 significance level. This is suggestive of the importance of location of practice to physicians' maturity level related to regional and provincial linkages (including access to integration tools ClinicalConnect, HRM and OLIS) as well as patient and community linkages (including patient portals, ancillary services, community programs, mental health, public health and population health resources). It is understandable when one considers the fact that physicians in the region with affiliation to Hamilton Health Sciences, for example, tended to be more aware and receptive of ClinicalConnect, not only because of access to support but also due to the historical, developmental association of ClinicalConnect to Hamilton Health Sciences. Compared to rural areas, urban centers such as Hamilton, London, Guelph and Windsor with higher concentration of larger scale infrastructure such as hospitals, colleges and universities, offer primary care practices the benefits of access to specialization and other indirect sources of technical support for EMR use.

It was surprising to hear repeated mentions of the American managed care consortium Kaiser Permanente in discussions about EMR integration in South Western Ontario. Despite clear differences between how health care is run and delivered in the United

States and Canada, participants pointed out practice type comparisons at health systems level. Several interviewees compared Ontario's approach to EMR integration with Kaiser Permanente, stating that Kaiser manages a regional operation that served a patient population base remarkably similar to Ontario's. Kaiser comprises 38 hospitals, 611 outpatient medical offices, and serves as one of America's largest managed health care organization, serving 9.1 million members in 7 states and the District of Columbia (Sempeles, 2014). According to Silvestre, Sue and Allen (2009), Kaiser deployed its electronic health record dubbed KP HealthConnect in 2004 to enhance electronic communication between physicians and patients. Physicians can connect with patients electronically, order diagnostic work, lab tests and consultations in addition to sending prescriptions directly to the pharmacy, provide medical literature and set alerts and reminders for follow-ups (Silvestre et al., 2009). Kaiser uses its National Products Council (NPC) to regularly take stock of latest technologies and how they could be integrated into its care models, weighing in on changing technologies, purchasing decisions, and evaluation of new devices, products, and services (Sempeles, 2014). In addition to primary care physicians, the group comprises representatives from laboratory, imaging, physiological monitoring, surgical, cardiology and orthopedic areas (Sempeles, 2014).

There are lessons in Kaiser's approach. First, implementation and effective use of EMR requires investments in change management. Second, regional integration entities that provide greater value to patients through new technologies need regular oversight from multidisciplinary teams to keep abreast of changes to technology and provide an avenue for consensus building when making decisions related to evaluation and acquisition of new devices, products, and services. Third, to deliver quality patient care throughout a wide expanse of health systems, facilities and providers, it is important to focus, not only on technology, but also on system design, placement of services, infrastructure and evidence-based methods of integration.

7.4 Impact of integrated EMR

The impact of regionally integrated EMR was examined from findings of observership, interview and questionnaire phases in response to the research question: how do physicians in primary care and family medicine experience the impact of integrated EMRs in South West Ontario? For the purpose of this analysis, impact was defined as the effect of EMR use on clinical care, described in statements about physician perceptions categorized under the themes of cherishing and loathing presented in Chapter 7. Furthermore, findings revealed more indications of impact of EMR than impact of integrated EMR.

Overall, this study indicated a positive impact of EMR use as most respondents showed satisfaction by rating EMR in their practices as excellent (18.4 %), very good (36.7 %), good or fair (38.8%), and most respondents (83%) would recommend their current EMR to other primary care physicians in the region. Moreover, the EMR was generally remotely available making it easier for physicians in the region to routinely access patient records from home or elsewhere other than the office. In a study about the impact of electronic medical records on physician practices, Lau et al (2012) found that the majority of studies showed either positive or no impact on primary care office practices; the study concluded by emphasizing the importance of having robust EMR features and patient engagement. Patients observed in our study did not appear to have negative impressions of physicians' use of EMR during visits. Similar to findings from this study, in a systematic review on the impact of an EMR on physician-patient relationship and communication, Alkureishi et al (2016) found that most studies analyzing patients' perception of physician EMR use reported no difference in overall patient satisfaction, communication or patient-physician relationship. For example, studies that examined interruptions to physician-patient speech patterns, gaze shifts, multi-tasking and sharing computer screen with patients showed no major change in overall patient satisfaction, while other studies highlighted situations where patients felt the EMR facilitated interaction with physicians including the process of communication, clarification, and discussion (Alkureishi et al., 2016).

Most respondents felt that access to personal health data was assured to be secure, private and confidential, and most physicians indicated that their system had never been breached or accessed inappropriately. This result may be due to inadequate mechanisms for detecting and reporting EMR data privacy, confidentiality and security breaches, for the following reasons. First, with expansion of EMR use and increasing awareness of the value of data contained in EMR and integrated systems, it is reasonable to expect more hacking events targeting vulnerable EMR data, keeping in mind that not all hacking events involve disruption to physician workflow (e.g., breaches aimed at harvesting EMR data). Without putting effective mechanisms in place to detect and report such events, personal health data may appear to be secure, private, and confidential when in fact they are not. Second, while performing routine audits on EMR data may help detect and report data breaches, most primary care organizations in the region do not perform such audits on a regular basis. Third, government incentives to adopt EMRs do not typically extend to EMR maintenance, making it difficult for community-based practices to adequately invest in security and privacy technologies necessary to maintain the EMR. Fourth, lack of connectivity to patients through portals and other technologies puts discussions of privacy, security, and confidentiality of information on the back burner. As more patient information becomes integrated and accessible to patients, demand for more accountability on privacy, security, and confidentiality of information through routine reports by vendors and organizations responsible for EMR roll-out and maintenance would become more pertinent. It is important to note that 76% of respondents reported having an individual in the practice responsible for ensuring quality, security and privacy of health information.

The Ontario Lab Information System (Ontario Ministry of Health and Long Term Care, 2004) was deemed impactful in that it allowed authorized health care providers to access lab test orders and results from hospitals, community labs, and public health labs. Our result further suggests that while physicians may have access to patient lab orders and results through OLIS, the typical physician may not have those lab orders or tests results linked to unique patient encounters due in part to lack of tools to link the EMR to lab reports, or lack of adequate knowledge or skill on the part of the physician to link unique lab reports to a patient encounter. Similarly, just as ClincalConnect supports access to real time clinical information, physicians benefitted from use of Hospital Report Manager (HRM) to securely receive patient reports electronically from participating hospital and specialty clinics.

Low impact aspects of integrated EMR were revealed to be aligned with the non-basic/more mature use levels of the model. For example, although 82% of questionnaire respondents agreed with the statement that the EMR in their practices provided tools to collect, store and update patient socio-economic information, such information captured within the CPP lacked linkages to contextual information about social determinants of health that a fully integrated regional information system could supply. It remains unclear how many physicians use social diagnostic codes (e.g., V codes in DSM-V and ICD-9, or ICD-10 Z-55 to Z65) to record principal reasons for patient encounter which could be used to capture patient conditions that may be a focus of clinical attention related to education. literacy and occupation, abuse and neglect, housing and related economic problems, crime and legal system issues, social environment problems, negative life events in childhood or problems related to upbringing and psychosocial circumstances (American Psychiatric Association, 2013; WHO, 2010). Results demonstrate that current EMRs fare badly regarding linking and exchanging information with public and population health resources and programs, mental health resources and programs, and with community resources, caregivers and programs that may support primary health care patient needs. Results further show that current EMRs do not allow users to securely track and coordinate ancillary services such as community services, transportation, interpretation, social services, case management and financial assistance tailored to individual patients.

A fully integrated EMR must support not only patient care needs related to primary, ambulatory, nursing home, emergency and hospital care, but also patient care needs related to social determinants of health. Wager et al (2000) examined the organizational impact of EMR on community-based primary care practices that have sailed through the initial hurdles of implementation and found that in addition to effective leadership, technical support and training, sufficient resources were essential elements to EMR success. The study further emphasized the importance of having a system champion to help effect change and combat challenges (Wager et al., 2000). Such roles become increasingly highly essential in the wake of clear recognition of greater need for fully functional and integrated regional health information systems.

7.5 Challenges to regionally integrated EMR use

Lack of integration consequently manifests in challenges to physician use of the EMR. One of the biggest challenges to regionally integrated EMR use is lack of interoperability, not only across EMR offerings, but also between the EMR and integration tools and devices. The 2013 Healthcare Information Management and Systems Society (HIMSS) definition described interoperability as the “ability of health information systems to work together within and across organizational boundaries in order to advance the effective delivery of healthcare for individuals and communities” (p.1). Interoperability is essential to the ability of different EMR and associated systems to exchange health information to assist providers in obtaining a comprehensive view of patients’ health information, yet it remains a complex, colossal and ongoing challenge to undertake. HIMSS classified three levels of interoperability as functional (one information system can receive data from another without need to interpret the data); structural (data can be exchanged between information systems with interpretation); and semantic (two or more systems can exchange information and the exchanged information can be used) (HIMSS Health Information and Management Systems Society, 2013). Fundamental to this classification is the ability to use the exchanged information. For information to be exchangeable and useable, information exchange must be standardized and coded. Respondents identified lack of standards as a limiting factor in their ability to exchange and use EMR data for patient care.

EMR transitioning imposes changes on clinicians' workflow. The need for data migration coupled with the need to learn how a new information system works often result in non-patient related, technical or administrative work, worsening workflow issues experienced by clinicians.

It was not surprising that cost would figure among prominent challenges that physicians faced because EMR adoption, implementation, and integration processes involved costly elements including setting up hardware, software costs, implementation support costs and training costs. It was however surprising that ongoing costs such as network fees and other maintenance costs were not considered as part of government incentives for the EMR. Essentially, EMR adoption was incentivized but not EMR use. The EMR landscape continually evolves with availability of regional integration tools and cloud-based technology, yet many smaller practices lack resources and technical expertise to fully benefit. Sourcing financial support is one of the major hurdles, especially for new physicians and smaller, rural and remote practices.

Despite 86% of respondents indicating that they used an EMR in their primary care practices, 14% reported not using an EMR. The reasons given showed that not everyone was open to the idea of using technology or giving up preferred paper-based clinical documentation processes. Top reasons expressed for lack of enthusiasm towards electronic documentation included reluctance to change brought about by EMR adoption and implementation, lack of clear indication of increase in efficiency, disruption to practice, cost of EMR adoption, the daunting process of converting from paper, lack of reliability, time consuming to learn, being more comfortable and faster with writing on or using paper, and nearing retirement. Rationalization of not using the EMR poses a challenge because patients of such physicians could be excluded from important measures or analyses involving electronic documentation. It imposes additional challenges of having to migrate or integrate patients' information electronically when luddites change practices or retire.

7.6 Competing perspectives on regional integration

Health information ecosystem in which primary health care physicians operate is one which, one could argue, has been liberated from the passive age of paper-based records to a networked ecosystem in which digital health presumably allows both care givers and patients to be active participants in the flow and use of health information. This research shows that the challenges to EMR use were neither exclusively technological nor uniquely the result of user behaviour. There are a plethora of ways by which governance and funding models used by provincial governments in Canada to administer and deliver health care services influence health information technologies and services. One could argue that what is important about ClinicalConnect, HRM, OLIS and other regional integration tools isn’t that they are regional or geographic but that they connect different parts of the health care system. For example, if someone got bloodwork done in St. Thomas, the technology worked the same as if they got it done in Chatham-Kent, and across provincial boundaries, if someone got bloodwork done in Gatineau, the technology worked the same as if they got it done on Ottawa. However, health information funding and administration decision making done through different operational units often lead to variation in access, quality, cost, training, level of awareness and engagement of primary care physicians. Consequently, there are a range of competing perspectives surrounding integration of electronic health information systems.

7.7 Emergent themes influence both perceptions of integration and use

Given the complexity of both EMR use and EMR integration, the emergent themes categorized as influencing perceptions of use and integration are not mutually exclusive. Working through change, meeting information needs, comparing practice contexts, managing patient expectations, engaging regional entities, and identifying support sources are entwined with influences on EMR use. To pursue advancement in EMR integration and use, implementation and evaluation of EMR in primary care will require recognition of inter-relatedness of the themes.

Chapter 8

8 Conclusion

8.1 Introduction

This thesis was an exploratory examination of issues relating to the use of regionally integrated electronic medical records by primary health care physicians in south western Ontario. Specifically, the thesis examined how EMR content, EMR offerings, integration tools, physician characteristics, practice types, information attributes and other related factors influence the overall use of EMR by the physicians. Examining regionally integrated EMR use from the perspective of primary care physicians not only contributes significantly to the overall understanding of a regionally integrated EMR, it also sheds light on how physicians use the EMR on a regular basis. The findings in the thesis make important contributions to our understanding of challenges of EMR integration; these findings were found to be germane to our understanding of ways of improving patient care and cannot be separated from a considered, in-depth analysis of factors influencing physician perceptions of EMR use. The study elaborates on current understanding of IS maturity models and presents a new, more pragmatic approach to evaluation of maturity levels from the perspective of regionally integrated EMR use. In this chapter, I conclude by briefly restating some of its major insights and contributions to EMR research, underlining some of the implications of the findings, briefly describing some of the thesis' limitations and highlighting potential directions for future research.

8.2 Synopsis of insights

The first research question examined the perceptions of primary health care physicians on regional integration of the EMR. The results indicated that perceptions of physicians were influenced by the need to facilitate care coordination and effectively communicate in real time, which implies recognition of the importance of the EMR as one way of improving quality of care. Physician perceptions were shaped by the effect on changes to workflow related to EMR transitioning and the need to manage patient expectations. Physician experiences often varied by practice context, meaning EMR use may be experienced differently by practitioners in urban versus rural settings which further implies variation in available support sources for EMR use. Respondents viewed data and information quality as prerequisites to strong patient care and placed value on timeliness, completeness, accuracy, and reliability of EMR data and information.

The second research question examined typical use of regionally integrated EMR in primary health care practices. The results showed that physicians used the EMR in a variety of ways and often took advantage of basic use features rather than more advanced, integrated features. Patients interact with caregivers with the expectation of full integration of patient information despite the apparent lack of full integration of patient portals or linkages to their physician's practice. The findings suggest that the EMR should be deployed in ways that foster integration with associated health information resources including pharmacies, other local health providers (other MDs, walk-in clinics), patient information (with two-way communication – access to data via a patient portal and integration of patient's own personal health data). The EMR is a powerful tool meant not merely to record patient encounters, but one that can be used to enable effective communication between patients and caregivers in order to improve patient outcomes.

The third research question examined factors influencing use of regionally integrated EMRs. The results showed characteristics of physicians and patients, along with EMR offering, EMR content, information attributes in terms of data and information quality and practice type all influenced physicians' perceptions of regionally integrated EMR use. The fourth question examined the impact of an integrated EMR. The study revealed positive impact of EMR use based on analysis of participant responses including EMR satisfaction rating. The fifth question explored challenges to regionally integrated EMR use and revealed lack of interoperability, costs and EMR migration figured prominently among the top challenges.

8.3 A comprehensive model of physician integrated EMR use

In response to these findings, this concluding chapter offers a model for understanding the use of the EMR among participants in this research. The model has two main purposes: (a) to simplify the complexity of factors associated with integrated EMR use and (b) to provide a framework for developing effective strategies aimed at addressing the challenges the primary health care physicians face in using regionally integrated EMR.

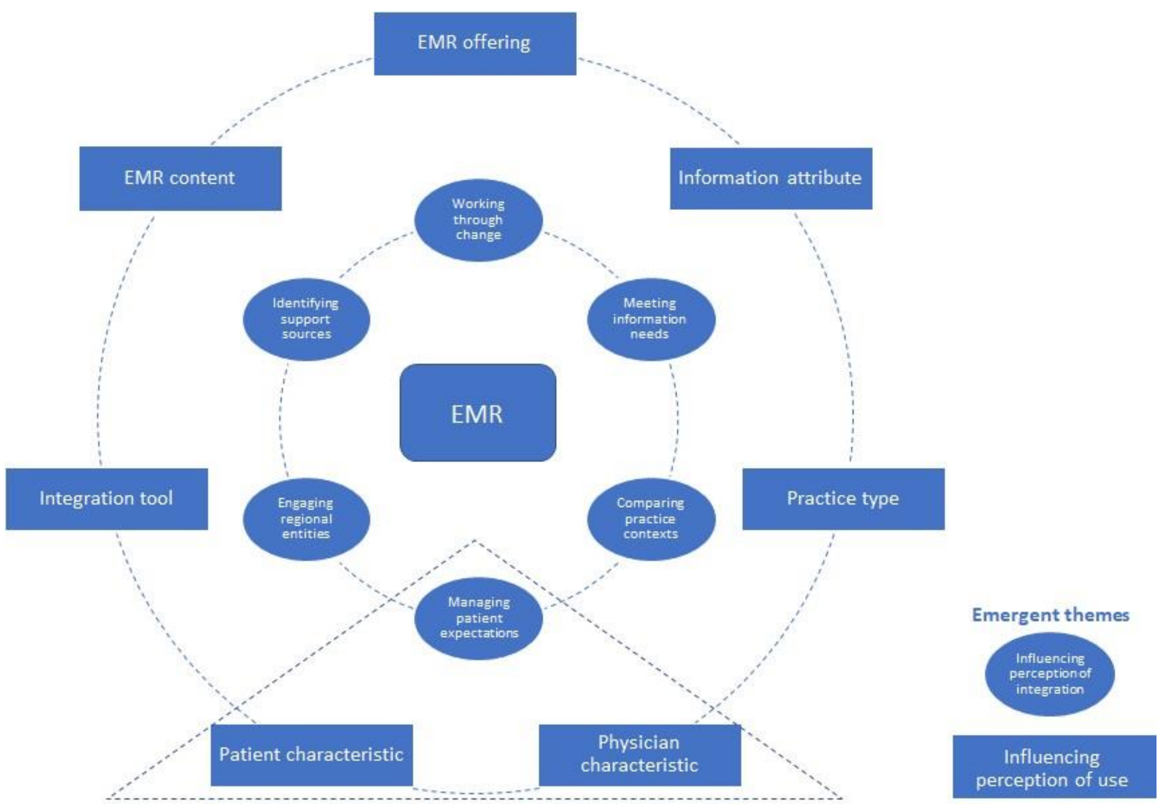

Figure 29. A comprehensive model of physician integrated EMR use

The novel comprehensive model of primary care physician regional integration EMR use presented above comprises the emergent themes from the grounded theory approach to analysis of data from the qualitative research phase. This model is robust given that its development was based on emergent themes influencing perception of integration, presented in the inner circle (oval), and emergent themes influencing perception of use, depicted in the outer circle (rectangle). The base triangle highlights patient facing themes at the foundation of regional integration. With EMR at the center, the themes are connected by dashed lines rather than solid lines to represent the continuously evolving nature of regional integration of EMR.

8.4 Contributions of the maturity model for regionally integrated EMR use

Since the advent of the EMR and proliferation of information technologies in health care, particularly those designed to support primary health care delivery, researchers have sought to understand and shed light on adoption of the EMR. To my knowledge, this thesis is the first attempt that goes beyond adoption to understand use of EMR in primary care in the context of regionally integrated EMR maturity models with focus on South West Ontario. My thesis sought to address limitations in previous assessment tools for the EMR. For example, several previously developed models and evaluation frameworks conflated adoption and use without adequately addressing importance of EMR integration to physician and patient needs. Implementation of maturity levels needs to be orderly to make it easier to guarantee not only accuracy but also replicability. Prior to this work, it was difficult to ascertain accuracy and replicability of various models on this topic because of lack of a common approach. This thesis provides an opportunity to have a common approach to assess or evaluate EMR maturity in primary health care.

The new maturity model presented in chapter 5 was developed to address shortcomings of previous models and provide a more robust basis for evaluating the use and impact of electronic health information resources in a regional setting. Previous models and frameworks originated outside of regional settings and were not developed to examine regional integration of electronic medical records. Moreover, physicians' views were often not incorporated. Based on participants' responses, this study established a model that incorporates the set of characteristics, features, indicators, attributes, patterns of EMR use or configurations that represent evolution, progression and attainment of an ideal state of EMR use from a regional integration perspective. The maturity model was developed to provide individual physicians and primary health care organizations with an ability to benchmark and assess progression over time and in comparison, to other physicians or primary care organizations in the region. Given that most processes in primary health care practices are no longer paper-based but electronic, the novel model's starting point emphasizes basic, non-integrated EMR use, compared to the Ontario MD maturity model. Figure 30 shows a side-by-side comparison of OntarioMD maturity model and the novel maturity model for regionally integrated EMR use.

Level	Criteria	Capabilities
5	**INTEGRATE**	Use of portals, hubs, attachment to provincial e-health platforms sharing data from the EMR.
4	**POPULATION DATA USE**	Dashboarding of whole populations, acting upon the whole, performing population analysis at the practice level.
3	**LOOK AHEAD / PREDICT**	Reminders and alerts are used at the point of care. Searches are done regularly and scheduled for review.
2	**EARLY DATA USE**	Acting upon the output of episodic searches, quick entry tools, forms, calculators, etc.
1	**ENTER DATA**	Documentation occurs electronically. Progress notes, forms, and other documents are entered into the EMR.
0	**PAPER**	Processes are primarily paper based.

Ontario MD Maturity Model.

Stage	Criteria	Capabilities
6	**PATIENT AND COMMUNITY RESOURCE LINKAGES**	Integration to support multi-platform, multi-directional communication with patients, community resources (patient portals, public health, mental health, population health, ancillary services, etc.).
5	**PERFORMANCE AND QUALITY IMPROVEMENT**	Integration to support clinical performance improvement, care coordination, shared-decision making, quality of information and care.
4	**REGIONAL AND PROVINCIAL LINKAGES**	Integration with HRM, OLIS, ClincalConnect, PrescribeIT and other regional, provincial integration tools.
3	**PRACTICE IMPROVEMENT**	Integration occurs with other solo, group or interdisciplinary practices and teams (tracking patients with multiple chronic conditions, preventative care, prescription, medication, etc.).
2	**BASIC USE PLUS**	Documentation occurs with integration within practice to generate lists, get lab results, and update patient family history or socio-economic information.
1	**BASIC USE**	Mainly primary health care office-based, non-integrated EMR use (billing and scheduling, CPP, allergy, etc.).

Novel Maturity Model for Regionally Integrated EMR Use.

Figure 30. Comparison between OntarioMD Maturity Model and Novel Maturity Model for Regionally Integrated EMR Use

The structure of the maturity model is comprised of stages or levels along an evolutionary scale representing basic EMR use, basic EMR use plus, practice improvement, regional and provincial linkages, performance and quality improvement, and patient and community resource linkages. The model could be easily modified, adapted, and applied in primary care settings.

Stage 1 comprises of items about EMR use for billing and scheduling, use of EMR to keep a continuous patient profile, ability to use the EMR to prescribe medication or generate a mediation list and retrieve patient allergy information. These items were determined as high scoring because the majority of respondents were found to use the EMR for billing and scheduling and indicated high familiarity with and use of features such as the CPP, use the EMR for prescribing and listing medication. This stage provides a starting point for progression to higher levels of maturity related to EMR use. Stage 2 comprises items related to recording and updating patient socio-economic information, patient family history information, alerts, OLIS data and laboratory information. Respondents were generally in agreement with statements indicating that the EMR in their practices provided tools to collect, store and update patient socio-economic information which was partly due to the presence of socio-economic information in the CPP or patient profile in the EMR. Similarly, a high percentage of respondents indicated that they received lab test results through Ontario Lab Information System (OLIS). Likewise, most physicians indicated that their EMR provided alerts for drug interactions, allergies, severe reactions and abnormal test results, while a similarly large percentage indicated that the EMR provides features to collect, store or update patient family information.

Stage 3 comprises of items about clinical summaries and ability to generate lists. It also incorporates information about use of tools such as tables and graphs to track and support patient care over time. At this stage, items were ranked in the mid-range, indicating moderate EMR use where use of EMR data progresses beyond the basics of the individual patient encounter, with view of patients within an entire practice for prevention, evaluation of health outcomes, communications with patients about a particular drug or condition. Stage 4 comprises items that captured information needed for reconciling differences between patient reported information and information existing in tools such as OLIS, HRM or other electronic health records, reaching outside of the physician practice to access patient information from other providers of care, thus, beginning to get at the heart of an integrated EMR. It also included items inquiring about routine use of HRM to retrieve details of patients' recent hospital visits, use of the regional integration tool ClinicalConnect and quality of data accessed through the regional integration tool in terms of timeliness, accuracy, and completeness.

Stage 5 comprised of low-scoring items related to ability of physicians to use the EMR to enter or synchronize patient data from devices such as mobile devices, using the EMR to allow patients to review, correct and update health information when updates are made to patients' information in the EMR, and providing tools to support coordination of patient needs related to ambulatory, nursing home, emergency and hospital care. Regarding clinical performance, this stage includes items exploring information on how clinical performance compared with other practices and whether physicians can assess clinical performance against regional, provincial, and national targets. Stage 6 comprises items related to asynchronous patient care, prescription refills, patient portals, appointment scheduling, and coordination of services with community resources including ancillary services, public and population health, mental health, use of multimedia and importation of data from other electronic health records.

This novel maturity model provides an opportunity to examine differences between and among the six stages of the model and selected covariates such as length of time a physician has had or used an EMR, how physicians rate the EMR in their practice, location of practice, age group, sex, and years of primary care practice. For example, despite small sample size, tests of differences showed that how physicians rated EMR currently in use in their practice was the most significant predictor of Stages 1, 2 and 3 which represents basic use, basic use plus and practice improvement stages, respectively.

Although sex appeared not to play a significant role as a predictor of what stage a physician might occupy on the maturity model, location of practice was found to be the most significant predictor of stage 4 of the model. It suggests that location of practice is strongly associated with regional and provincial linkages stage. Understandably, compared with primary care physicians working in remote areas of south western Ontario region, those working in more urban centers such as Hamilton may find it easier to access support for regional integration tools such as ClinicalConnect, and as such, move higher up the evolutionary scale of the maturity model. ClinicalConnect was developed and maintained by Hamilton Health Sciences.

Essentially, the six-stage maturity model provides a framework describing key elements of operative EMR use within the context of regional integration of electronic health information resources. It shifts orientation of EMR maturity from an evolutionary improvement path which characterized prior maturity models, to how physicians actually use EMR in primary health care. EMR maturity is not based on ad-hoc processes going from immature to mature levels. Instead, it characterizes and structures maturity levels by respondent views, based on actual EMR use that reflects the needs of physicians and patients.

8.5 Contributions of the study

One of the strengths of this research is its use of multiple data sources. By examining EMR use irrespective of the dreariness attached to data preparation and analysis from multiple sources, I acquired a rich and wide-ranging pool of information. Observership, survey and interviews provided me with deep insights into actual experiences of primary care physicians. First, the study contributes to expansion of our conceptual understanding of current status of EMR use in a regional setting, which is critical to better understanding not only the benefits and drawbacks of EMRs, but also important factors associated with regional integration and application of maturity models to regional settings. Second, the study is timely in the sense that primary health care practitioners were studied in the context of current efforts to integrate EMR with regional electronic health information resources. It sheds light on how regional integration enhances or impedes their electronic health information needs and uses which would be informative to regional, provincial, national, and international programs aimed at improving physician and patient experiences. Third, novel models generated from this research could be used as practical framework for future electronic health information evaluations of use and impact of EMR as it provides the set of parameters necessary to serve as springboard for new analyses and comparisons.

Finally, the findings from this research have implications for health information science researchers and professionals, EMR developers and patients, not just physicians in primary care. Analysts, implementation leads, evaluation practitioners and academic researchers in the field of Health Information Science could use knowledge generated from this research to obtain a more comprehensive understanding of the factors central to EMR use and impact in primary health care, the nature of the information needs at different stages of research on the EMR in primary care, the nature of the information needs in primary health care, and better knowledge and understanding of regional integration of EMR. This knowledge and understanding can be adopted and applied to training health information professionals who will be able to better communicate with information system developers and users, serving as indispensable liaisons between developers and users in order to improve delivery of both information technologies and services on one hand, and health and health care services on the other hand. It is expected that the findings will serve to inform new health information professionals about the nature of the field. Those entering the field may not have a clear understanding of the research process which may be widely applied because, unlike other well-established fields and disciplines in the sciences and arts, Health Information Science continues to evolve; a single, overarching research methodology has yet to be established. The results of the study might help to inform development of policies in the area of electronic medical records specifically and eHealth generally. In addition, the findings may be employed to raise awareness and recognition of EMR literacy, skills, knowledge, and the Health Information Science's contribution to quality healthcare.

8.6 Study limitations

It may be difficult to generalize findings from this research to other areas without further collection and analysis of related data given that the study focused on one particular region. The number of participants was limited to 101 who voluntarily chose to participate in different phases of the research, and due to cost and logistics of recruitment, I was unable to recruit more physicians. Increasing the sample size of the survey component would have given me more insight into different perspectives of physicians and would have increased quantitative findings to significance levels in some cases, since higher sample size is likely to increase the confidence of the results. Essentially, the findings presented in this document should be seen as demonstrating exploratory indications rather than confirmatory or absolute measures. The findings though were consistent across all three means of exploring the topic – observership, survey and qualitative interview and thus indicate a high degree of overlap and evidence of the real situation in the region.

The study was investigated in South West Ontario which would make the immediate results limited to that locality. However, the context of the topics under investigation in the research can have similarities with primary care physicians in other regions in Canada and elsewhere, that have comparable EMR use experiences. An ideal recruitment from the qualitative phase of this research would involve recruiting participants from multiple regions. However, this was not within scope for this research given the limited amount of time and resources available for the project. Inclusion of physicians from multiple regions would have produced results that were better reflective of the broader population and by extension, the results would have potential applicability to a broader audience. Nonetheless, this research has shown that participants in this study are in several ways comparable and similar to primary care physicians in other regions in Canada and across the world. For this reason, the knowledge acquired from this thesis will be useful to many physicians and other stakeholders interested in applying maturity models to primary health care practices.

The maturity model has limitations. First, this research was done under the supervision of a principal investigator who believed that it was sufficient to map research questionnaire items into a maturity model without establishing a framework and a rating method. Second, the levels of the maturity model are not mutually exclusive. A physician occupying a lower level may equally occupy a higher level, only at a different rate. Third, the choice and selection of items within each stage indicate both physician behavior in relation to EMR use and features of EMR. Establishing a framework that distinguishes between physician behavior and EMR features and incorporating rating thresholds per maturity level would enhance the quality, reliability, and validity of the model.

Inclusion of participant quotations, despite being consistent with grounded theory, might be viewed as excessive, given the considerable length that they add to the thesis. I rationalize their use by emphasizing the relatively few studies that actually incorporated physician perspectives in their own words in examination of regional integration of EMR use because I wanted to provide a detailed and thorough portrayal of physicians' experiences in the region in order to develop a robust comprehensive model of integrated EMR use.

The use of physician opinions and experiences as proxy for patients' perspectives, opinions and experiences is a significant limitation. Despite physicians being trained professionals with responsibility for patient care, it is essential to generate knowledge and derive clear understanding of patients through direct inquiry. Patient use of electronic health information resources is an area of minimal research as the use and impact of EMR or patient portals are not receiving adequate attention from researchers. To deliver the best care possible to patients, perspectives and opinions of patients are critical. Just as it is essential to have adequate knowledge of the benefits and factors that influence physician use of EMRs, patient use of electronic health information resources and barriers or challenges they face in the process must be continually examined.

Study limitation pertaining to the qualitative research phase relates to thfe notion of subjectivity in interpreting mixed methods grounded theory research results. Over the years, this notion has gained prominence among researchers as an inherent part of qualitative research, making it necessary to justify, not only account for, the researcher's subjective interpretive input in the research process. In essence, it is impossible for the researcher to bring a totally open, non-biased, mind into a research project. Therefore, it is important to acknowledge the interpretive latitude that the qualitative research approach applied in this thesis afforded me to produce results that may be construed as being influenced by my subjective biases as the researcher. To ensure reliable results, Tracy's eight "big-tent" criteria for quality presented in Chapter 3 were rigorously applied. Moreover, the evaluative questions raised by Strauss and Corbin equally presented in Chapter 3, were vigorously taken into consideration.

8.7 Future work

This thesis provides new opportunities for future research to employ confirmatory approaches to elaborate upon and test the findings, and develop enhanced understanding of the emergent themes, conceptual categories, and indicators at different stages of the maturity model. This work provides the foundation for evaluation activities for regionally integrated EMR in south west Ontario and forms the basis for potential activities as insights gained within the region will be valuable for refining the models for future application not only to the region, but also future adaptations to other regions. Recognizing the importance of and need for patient perspectives, I have interest in further investigating the dimensions of electronic health information access, use and evaluation from the patients' angle, particularly the use and impact of patient portals, synchronous and asynchronous patient care, and multi-directional communications mechanisms with potential to improve health care access and delivery. Future work should be directed towards providing needed linkages to achieve a fully integrated model of an ideal EMR that research participants envisioned.

References

Adams, G., & Schvaneveldt, J. (1991). *Understanding Research Methods*. Longman. https://books.google.com.my/books/about/Understanding_research_methods.html?id=I77tAAAAMAAJ

Adenuga, O. A., Kekwaletswe, R. M., & Coleman, A. (2015). eHealth integration and interoperability issues: towards a solution through enterprise architecture. *Health Information Science and Systems*, *3*, 1. https://doi.org/10.1186/s13755-015-0009-7

Ahern, D. K. (2007). Challenges and Opportunities of eHealth Research. *American Journal of Preventive Medicine*, *32*(5 SUPPL.). https://doi.org/10.1016/j.amepre.2007.01.016

AHS Alberta Health Services. (2018). *About Alberta Health Services*. https://www.albertahealthservices.ca/about/about.aspx

Alexander, T. (2016a). *Benefits Realization: Early Psychosis Treatment*. https://www.ehealthontario.on.ca/images/uploads/regional_partners/cSWO_BR_-_Early_Psychosis_Intake_FINAL_0616.pdf

Alexander, T. (2016b). *Week 8 Lecture: Overview of cSWO and cSWO Regional HIS by VP, eHealth Centre of Excellence*. HIS UWO Health Informatics Dr. Candace Gibson Class.

Alexander, T., Huebner, L. A., Alarakhia, M., & Hollohan, K. (2017). The Connecting South West Ontario (cSWO) benefits model: An approach for the collaborative capture of value of electronic health records and enabling technology. *Studies in Health Technology and Informatics*. https://doi.org/10.3233/978-1-61499-742-9-6

Alin, A. (2010). Multicollinearity. *Wiley Interdisciplinary Reviews: Computational Statistics*. https://doi.org/10.1002/wics.84

Alkin, M., & Christie, C. (2004). An evaluation theory tree. *Evaluation Roots: Tracing Theorists' Views …*, 12–65. https://doi.org/10.1016/j.stueduc.2008.07.001

Alkureishi, M. A., Lee, W. W., Lyons, M., Press, V. G., Imam, S., Nkansah-Amankra, A., Werner, D., & Arora, V. M. (2016). Impact of Electronic Medical Record Use on the Patient–Doctor Relationship and Communication: A Systematic Review. *Journal of General Internal Medicine*. https://doi.org/10.1007/s11606-015-3582-1

Alvarez, R. (2004). The electronic health record: a leap forward in patient safety. In *HealthcarePapers.* (Vol. 5, Issue 3).

Alvarez, R. C. (2002). The promise of e-Health - a Canadian perspective. *Ehealth International*, *1*(1), 4. https://doi.org/10.1186/1476-3591-1-4

Alwan, M., & Felder, R. (2008). Eldercare Technology for Clinical Practitioners. *Activities, Adaptation & Aging*. https://doi.org/10.1080/01924780903295754

American Psychiatric Association. (2013). DSM-5 Diagnostic Classification. In *Diagnostic and Statistical Manual of Mental Disorders*. https://doi.org/10.1176/appi.books.9780890425596.x00diagnosticclassification

Ammenwerth, E., Gräber, S., Herrmann, G., Bürkle, T., & König, J. (2003). Evaluation of health information systems—problems and challenges. *International Journal of Medical Informatics*, *71*(2), 125–135. https://doi.org/10.1016/S1386-5056(03)00131-X

Anderson, J. G. (2007a). Social, ethical and legal barriers to E-health. *International*

Journal of Medical Informatics, *76*(5–6), 480–483. https://doi.org/10.1016/j.ijmedinf.2006.09.016

Anderson, J. G. (2007b). Social, ethical and legal barriers to E-health. *International Journal of Medical Informatics*. https://doi.org/10.1016/j.ijmedinf.2006.09.016

Aqil, A., Lippeveld, T., & Hozumi, D. (2009). PRISM framework: A paradigm shift for designing, strengthening and evaluating routine health information systems. *Health Policy and Planning*, *24*(3), 217–228. https://doi.org/10.1093/heapol/czp010

Archer, N., & Cocosila, M. (2014). Canadian patient perceptions of electronic personal health records: An empirical investigation. *Communications of the Association for Information Systems*, *34*(1), 389–406.

Ashcroft, S., Pereira, C., Ashcroft, S., & Pereira, C. (2003). The Kruskal-Wallis test. In *Practical Statistics for the Biological Sciences*. https://doi.org/10.1007/978-1-137-04085-5_11

Barnett, J., & Jennings, H. (2009). Pharmacy information systems in Canada. *Studies in Health Technology and Informatics*, *143*, 131–135. https://doi.org/10.3233/978-1-58603-979-0-131

Bassi, J., Lau, F., & Lesperance, M. (2012a). Perceived impact of electronic medical records in physician office practices: A review of survey-based research. In *Journal of Medical Internet Research* (Vol. 14, Issue 4). https://doi.org/10.2196/ijmr.2113

Bassi, J., Lau, F., & Lesperance, M. (2012b). Perceived impact of electronic medical records in physician office practices: A review of survey-based research. In *Journal of Medical Internet Research* (Vol. 14, Issue 4). https://doi.org/10.2196/ijmr.2113

Bateman, E. H., & Keefe, D. M. K. (2016). How can eHealth enhance adherence to cancer therapy and supportive care? *Srpski Arhiv Za Celokupno Lekarstvo*, *144*(1–2), 116–121. https://doi.org/10.2298/SARH1602116B

Bone, R. (2017). *The regional geography of Canada* (7th ed.). Oxford University Press.

Booth, R. G., Sinclair, B., Brennan, L., & Strudwick, G. (2017). Developing and implementing a simulated electronic medication administration record for undergraduate nursing education: Using socio technical systems theory to inform practice and curricula. *CIN - Computers Informatics Nursing*, *35*(3), 131–139. https://doi.org/10.1097/CIN.0000000000000309

Borrelli, B., & Ritterband, L. M. (2015). Special issue on eHealth and mHealth: Challenges and future directions for assessment, treatment, and dissemination. *Health Psychology*. https://doi.org/10.1037/hea0000323

Borycki, E. M., Newsham, D., & Bates, D. W. (2013). eHealth in North America. *Yearbook of Medical Informatics*, *8*(1), 103–106. http://www.ncbi.nlm.nih.gov/pubmed/23974555

Borycki, E., Sangster-Gormley, E., Schreiber, R., Thompson, J., Griffith, J., Feddema, A., & Kuo, A. (2014). How are Electronic Medical Records Used by Nurse Practitioners? *Studies in Health Technology and Informatics*, *205*, 196–200. https://doi.org/10.3233/978-1-61499-432-9-196

Bourn, M., & Davies, C. (1996). A prodigious information systems failure. *Health Information Management*, *17*(2), 34–44.

Braeken, J., & Van Assen, M. A. L. M. (2017). An empirical Kaiser criterion.

Psychological Methods. https://doi.org/10.1037/met0000074

Brender, J. (2006a). Handbook of Evaluation Methods for Health Informatics. In *Handbook of Evaluation Methods for Health Informatics*. https://doi.org/10.1016/B978-012370464-1.50011-3

Brender, J. (2006b). Handbook of Evaluation Methods for Health Informatics. In *Handbook of Evaluation Methods for Health Informatics*. https://doi.org/10.1016/B978-012370464-1.50011-3

Bunniss, S., & Kelly, D. R. (2010). Research paradigms in medical education research. *Medical Education*. https://doi.org/10.1111/j.1365-2923.2009.03611.x

Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin*. https://doi.org/10.1037/h0046016

Canada Health Infoway. (2007). *Canada Health Infoway Benefits Evaluation Framework*. https://www.infoway-inforoute.ca/en/what-we-do/research-and-insights/benefits-evaluation/benefits-evaluation-framework

Canada Health Infoway. (2012). *Infoway Benefits Evaluation Framework*. https://www.infoway-inforoute.ca/en/what-we-do/research-and-insights/benefits-evaluation/benefits-evaluation-framework

Canada Health Infoway. (2014). *Annual Report 2014-2015 Canada Health Infoway*. https://www.infoway-inforoute.ca/en/component/tags/tag/12-annual-report

Canada Health Infoway. (2018). *Understanding EHRs, EMRs and PHRs*. Digital Health Foundation. https://www.infoway-inforoute.ca/en/solutions/digital-health-foundation/understanding-ehrs-emrs-and-phrs

Canada Health Infoway. (2019). *PrescribeIT New Features Now Available*. PrescribeIT. https://www.infoway-inforoute.ca/en/what-we-do/news-events/newsroom/2020-news-releases/8403-prescribeit-new-features-now-available

Canadian Healthcare Technology. (2016). Nightingale sells Canadian assets to Telus. *Canadian Healthcare Technology*. https://www.canhealth.com/2016/07/20/nightingale-sells-canadian-assets-to-telus/

Canadian Institute for Health Information. (2016). *How Canada Compares: Results From The Commonwealth Fund 2015 International Health Policy Survey of Primary Care Physicians* (p. 65). https://secure.cihi.ca/estore/productSeries.htm?pc=PCC1251

Canadian Institute for Health Information. (2019). Summary report: Physicians in Canada 2018. In *Canadian Institute for Health Information*. https://www.cihi.ca/sites/default/files/document/physicians-in-canada-2018.pdf

Canadian Medical Association. (2014). How Can Canada Achieve Enhanced Use of Electronic Medical Records? *Canadian Medical Association*, *May*, 1–18. http://tinyurl.com/zz9wfrm

Canadian Medical Association, & Canadian Pharmacists Association. (2013). e-Prescribing Joint Statement. *Health Care Transformation in Canada Canadian Medical Association Canadian Pharmacists Association, December 2012*. http://www.pharmacists.ca/cpha-ca/assets/File/ePrescribingStatementENG2013.pdf

Canadian Nurses Association. (2003). Five Principles of Primary Health Care. *CNA Backgrounder*. https://www.cna-aiic.ca/~/media/cna/page-content/pdf-en/bg7_primary_health_care_e.pdf?la=en

Canadian Nurses Association. (2005). *CNA Position Statement on Primary Health Care*. https://cna-aiic.ca/en/on-the-issues/better-health/primary-health-care

Caralli, R., Knight, M., & Montgomery, A. (2012). *Maturity models 101: a primer for applying maturity models to smart grid security, resilience, and interoperability*. *November*, 1–10. http://resources.sei.cmu.edu/asset_files/WhitePaper/2012_019_001_58920.pdf

Chami, N., Simons, J. E., Sweetman, A., & Don-Wauchope, A. C. (2017). Rates of inappropriate laboratory test utilization in Ontario. *Clinical Biochemistry*. https://doi.org/10.1016/j.clinbiochem.2017.05.004

Chan, D. (2018). *OSCAR EMR*. OSCAR EMR.

Chang, F., & Gupta, N. (2015). Progress in electronic medical record adoption in Canada. *Canadian Family Physician*. https://doi.org/1076 [pii]

Charmaz, K. (2000). Grounded theory: Objectivist and constructivist methods. In *Handbook of qualitative research*. https://doi.org/10.1007/s13398-014-0173-7.2

Charmaz, K. (2011). GROUNDED THEORY METHODS IN SOCIAL JUSTICE RESEARCH. In *(The SAGE Handbook of Qualitative Research*. https://doi.org/10.1108/09504120610655394

Charmaz, K. (2014a). Constructing grounded theory: a practical guide through qualitative analysis. In *Book*. https://doi.org/003

Charmaz, K. (2014b). Grounded Theory in Global Perspective : Reviews by International

Researchers. *Qualitative Inquiry*, *20*(9), 1074–1084. https://doi.org/10.1177/1077800414545235

Charmaz, K., & Belgrave, L. L. (2012). Qualitative interviewing and grounded theory analysis. In *The SAGE Handbook of Interview Research: The Complexity of the Craft*. https://doi.org/10.4135/9781452218403.n25

Chaudhry, B., Wang, J., Wu, S., Maglione, M., Mojica, W., Roth, E., Morton, S. C., & Shekelle, P. G. (2006). Systematic review: Impact of health information technology on quality, efficiency, and costs of medical care. In *Annals of Internal Medicine* (Vol. 144, Issue 10, pp. 742–752). https://doi.org/0000605-200605160-00125 [pii]

Cho, E., & Kim, S. (2015). Cronbach's Coefficient Alpha: Well Known but Poorly Understood. *Organizational Research Methods*. https://doi.org/10.1177/1094428114555994

CIHI. (2014). *Primary Health Care*. https://www.cihi.ca/en/types-of-care/primary-health-care

Cliff, N. (1988). The Eigenvalues-Greater-Than-One Rule and the Reliability of Components. *Psychological Bulletin*. https://doi.org/10.1037/0033-2909.103.2.276

CMA. (2013). *2013 National Physician Survey*. http://nationalphysiciansurvey.ca/surveys/2013-survey/

COACH Canada's Health Informatics Association. (2013). *Canadian EMR Adoption and Maturity Model*. *February*.

Cocosila, M., & Archer, N. (2017). Practitioner pre-adoption perceptions of Electronic Medical Record systems. *Behaviour and Information Technology*.

https://doi.org/10.1080/0144929X.2017.1303083

College of Family Physicians of Canada. (1986). *Four Principles of Family Medicine*. CFPC Principles. http://www.cfpc.ca/principles/

College of Family Physicians of Canada. (2011). *Patient's Medical Home*. Patient's Medical Home. http://patientsmedicalhome.ca/

Collier, R. (2015). National Physician Survey: EMR use at 75%. In *CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne*. https://doi.org/10.1503/cmaj.109-4957

Corbin, J., & Strauss, A. (2012). Basics of Qualitative Research (3rd ed.): Techniques and Procedures for Developing Grounded Theory. In *Basics of Qualitative Research (3rd ed.): Techniques and Procedures for Developing Grounded Theory*. https://doi.org/10.4135/9781452230153

Coyne, I. T. (1997). Sampling in qualitative research. Purposeful and theoretical sampling; merging or clear boundaries? *Journal of Advanced Nursing*. https://doi.org/10.1046/j.1365-2648.1997.t01-25-00999.x

Cresswell, K. M., Bates, D. W., & Sheikh, A. (2013). Ten key considerations for the successful implementation and adoption of large-scale health information technology. *Journal of the American Medical Informatics Association : JAMIA*, *20*(e1), e9–e13. https://doi.org/10.1136/amiajnl-2013-001684

Creswell, J. . (2009). Mixed methods procedures. *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*, 203–226.

Creswell, J. W., & Plano-Clark, V. (2007). Understanding mixed methods research. In

Designing and conducting mixed methods research. https://doi.org/10.1016/j.aenj.2008.02.005

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*. https://doi.org/10.1007/BF02310555

Cuggia, M., Herry, N., Rossille, D., Lepage, E., Edan, G., & Le Beux, P. (2006). A model for a regional health information network sharing clinical information between professionals in Britanny. *Stud Health Technol Inform*, *124*, 449–454. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=17108560

Davis, P. (2006). *Exploratory Research* (V. Jupp (ed.)). Sage Research Methods. https://doi.org/https://dx.doi.org/10.4135/9780857020116.n75

de Carvalho, J. V., Rocha, Á., & Vasconcelos, J. (2015). Towards an Encompassing Maturity Model for the Management of Hospital Information Systems. *Journal of Medical Systems*, *39*(9). https://doi.org/10.1007/s10916-015-0288-1

de Winter, J. C. F., Dodou, D., & Wieringa, P. A. (2009). Exploratory factor analysis with small sample sizes. *Multivariate Behavioral Research*. https://doi.org/10.1080/00273170902794206

DeCuir-Gunby, J. T., Marshall, P. L., & McCulloch, A. W. (2011). Using mixed methods to analyze video data: A mathematics teacher professional development example. *Journal of Mixed Methods Research*, *6*(3), 199–216. https://doi.org/10.1177/1558689811421174

DeLone, W., & McLean, E. (1992). Information Systems Success: The Quest for the

Dependent Variable. *Information Systems Research*, *3*(1), 60–95. https://doi.org/10.1287/isre.3.1.60

DeLone, W., & McLean, E. (2003). The DeLone and McLean Model of Information Systems Success : A Ten-Year Update. *Journal of Management Information Systems*, *19*(4), 9–30. https://doi.org/10.1073/pnas.0914199107

Denzin, N. K., & Lincoln, Y. S. (2000). The discipline and practice of qualitative research. In *Handbook of Qualitative Research* (pp. 1–28).

Denzin, N. K., & Lincoln, Y. S. (2011). The Sage Handbook of Qualitative Research. In *The Sage Handbook of Qualitative Research* (Vol. 1, Issue 1).

Devarakonda, M. V., Mehta, N., Tsou, C. H., Liang, J. J., Nowacki, A. S., & Jelovsek, J. E. (2017). Automated problem list generation and physicians perspective from a pilot study. *International Journal of Medical Informatics*, *105*(May), 121–129. https://doi.org/10.1016/j.ijmedinf.2017.05.015

Duplaga, M. (2015). A cross-sectional study assessing determinants of the attitude to the introduction of eHealth services among patients suffering from chronic conditions eHealth/ telehealth/ mobile health systems. *BMC Medical Informatics and Decision Making*, *15*(1). https://doi.org/10.1186/s12911-015-0157-3

Eapen, B. R., & Chapman, B. (2015). Mobile Access to ClinicalConnect: A User Feedback Survey on Usability, Productivity, and Quality. *JMIR MHealth and UHealth*. https://doi.org/10.2196/mhealth.4011

eHealth Ontario. (2014). *Ontario's eHealth Blueprint Indepth*. https://www.ehealthontario.on.ca/images/uploads/pages/documents/Blueprint_Book.

pdf

eHealth Ontario. (2016). *Connecting Ontario*. EHealth Ontario. http://www.ehealthontario.on.ca/en/initiatives/view/ConnectingOntario

Elbert, N. J., Van Os-Medendorp, H., Van Renselaar, W., Ekeland, A. G., Hakkaart-Van Roijen, L., Raat, H., Nijsten, T. E. C., & Pasmans, S. G. M. A. (2014). Effectiveness and cost-effectiveness of ehealth interventions in somatic diseases: A systematic review of systematic reviews and meta-analyses. In *Journal of Medical Internet Research* (Vol. 16, Issue 4). https://doi.org/10.2196/jmir.2790

Evans, R. S. (2016). Electronic Health Records: Then, Now, and in the Future. *Yearbook of Medical Informatics*, S48–S61. https://doi.org/10.15265/IYS-2016-s006

Eysenbach, G. (2001). What is e-health? *Journal of Medical Internet Research*, *3*(2), 1–5. https://doi.org/10.2196/jmir.3.2.e20

Falzon, D., Raviglione, M., Bel, E. H., Gratziou, C., Bettcher, D., & Migliori, G. B. (2015). The role of eHealth and mHealth in tuberculosis and tobacco control: A WHO/ERS consultation. In *European Respiratory Journal*. https://doi.org/10.1183/09031936.00043315

Filstead, W. (1979). Qualitative methods: a needed perspective in evaluation research. In T. Cook & R. Reichardt (Eds.), *Qualitative and Quantitative Methods in Evaluation Research* (Sagq).

Fink, A. S. (2000). The Role of the Researcher in the Qualitative Research Process. A Potential Barrier to Archiving Qualitative Data. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research, 1(3), Art. 4*, *1*(3), 69.

Finlay, L., & Ballinger, C. (2006). *Qualitative Research for Allied Health Professionals*.

Fogel, A. L., & Sarin, K. Y. (2017). A survey of direct-to-consumer teledermatology services available to US patients: Explosive growth, opportunities and controversy. *Journal of Telemedicine and Telecare*. https://doi.org/10.1177/1357633X15624044

Frederix, I., Hansen, D., Coninx, K., Vandervoort, P., Vandijck, D., Hens, N., Van Craenenbroeck, E., Van Driessche, N., & Dendale, P. (2015). Medium-term effectiveness of a comprehensive internet-based and patient-specific telerehabilitation program with text messaging support for cardiac patients: Randomized controlled trial. *Journal of Medical Internet Research*. https://doi.org/10.2196/jmir.4799

Friedman, C. P., & Wyatt, J. C. (2006). Evaluation methods in biomedical informatics. In *Nursing* (Vol. 49). http://books.google.nl/books?id=o2XyIpz_I1sC

Frost, D. W., Vembu, S., Wang, J., Tu, K., Morris, Q., & Abrams, H. B. (2017). Using the Electronic Medical Record to Identify Patients at High Risk for Frequent Emergency Department Visits and High System Costs. *American Journal of Medicine*, *130*(5), 601.e17-601.e22. https://doi.org/10.1016/j.amjmed.2016.12.008

Fuller, S. (1997). Regional Health Information Systems: Applying The IAIMS Model. *Journal of the American Medical Informatics Association : JAMIA*, *4*(2 Suppl), S47-51. http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=61491&tool=pmcentrez&rendertype=abstract

Gagnon, M.-P., Desmartis, M., Labrecque, M., Légaré, F., Lamothe, L., Fortin, J.-P., Rancourt, J.-F., & Duplantie, J. (2010). Implementation of an electronic medical record in family practice: a case study. *Informatics in Primary Care*.

Gagnon, M., Payne-Gagnon, J., Breton, E., Fortin, J. P., Khoury, L., Dolovich, L., Price, D., Wiljer, D., Bartlett, G., & Archer, N. (2016). Adoption of electronic personal health records in Canada: Perceptions of stakeholders. *International Journal of Health Policy and Management*. https://doi.org/10.15171/ijhpm.2016.36

Galliers, R. D., & Sutherland, A. R. (1991). Information systems management and strategy formulation: the ???stages of growth??? model revisited. *Information Systems Journal*, *1*(2), 89–114. https://doi.org/10.1111/j.1365-2575.1991.tb00030.x

Gardner, B. (2006). *Local Health Integration Networks: Potential, Challenges and Policy Directions* (Issue January). https://www.wellesleyinstitute.com/wp-content/uploads/2011/11/LHINs_PCh_Paper2.pdf

Gaynor, M., Yu, F., Andrus, C. H., Bradner, S., & Rawn, J. (2014). A general framework for interoperability with applications to healthcare. *Health Policy and Technology*, *3*(1), 3–12. https://doi.org/10.1016/j.hlpt.2013.09.004

Gibson, W., & Brown, A. (2009). Reserach Design. In *Working with Qualitative Data*.

Gibson, C. (2016). *Week 13 Lecture: The future of Health Technology* [PowerPoint slides]. Retrieved from MHI 4100F/9100F Western University OWL Sakai site.

Giddings, L. S., & Grant, B. M. (2007). A Trojan horse for positivisim? A critique of mixed methods research. *Advances in Nursing Science*, *30*(1), 52–60. papers2://publication/uuid/D47DC68A-1815-4D49-9531-7202BF269BE5%5Cnfile:///Users/adamday/Documents/Mendeley Desktop/Giddings et al/2007/Giddings et al. - 2007 - A Trojan horse for positivisim

A critique of mixed methods research.pdf

Glanville, J., Kendrick, T., McNally, R., Campbell, J., & Hobbs, F. D. R. (2011). Research output on primary care in Australia, Canada, Germany, the Netherlands, the United Kingdom, and the United States: bibliometric analysis. *BMJ (Clinical Research Ed.)*. https://doi.org/10.1136/bmj.d1028

Glaser, B. G., & Strauss, A. L. (1967). The discovery of grounded theory. *International Journal of Qualitative Methods*. https://doi.org/10.2307/588533

Glen, S. (2016). Kaiser-Meyer-Olkin (KMO) Test for sampling adequacy. *From statisticshowto.com: Elementary statistics for the rest of us!* Retrieved from https://www.statisticshowto.com/kaiser-meyer-olkin/

Gliner, J., & Morgan, G. (2000). *Research Methods in Applied Settings: An IntegratedApproach to Design and Analysis*. Lawrence Erlbaum Associates, Publishers.

Gooch, J. W. (2011). Kruskal-Wallis Test. In *Encyclopedic Dictionary of Polymers*. https://doi.org/10.1007/978-1-4419-6247-8_15268

Government of Australia. (2007). Australian Interoperability Maturity Model. *NEHTA*. https://www.digitalhealth.gov.au/implementation-resources/ehealth-foundations/EP-1143-2006/NEHTA-0062-2007

Government of Ontario. (2012). Ontario’s Action Plan For Health Care: Better patient care through better value from our health care dollars. *Ontario ’ s Action Plan For Health Care Better*, 1–16. https://doi.org/800/01/12 Cat.# 016827 ISBN 978-1-4435-8942-0.

Greenhalgh, T., Potts, H., Wong, G., Bark, P., & Swinglehurst, D. (2009). Tensions and Paradoxes in Electronic Patient Record System: A Systematic Literature Review Using the Meta-narrative Method. *The Millbank Quarterly*, *87*(4), 729–788. https://doi.org/10.1111/j.1468-0009.2009.00578.x

Grunig, J. E., & Grunig, L. A. (1998). The relationship between public relations and marketing in excellent organizations: Evidence from the IABC study. *Journal of Marketing Communications*. https://doi.org/10.1080/135272698345816

Guba, E. G., & Lincoln, Y. S. (1981). Effective Evaluation. *Evaluation*, *107*(march), xxi, 423 p. https://doi.org/10.1002/pfi.181

Guba, E. G., & Lincoln, Y. S. (1988). Do inquiry paradigms imply inquiry methodologies? In D. Fetterman (Ed.), *Qualitative approaches to evaluation in education: The silent scientific revolution* (pp. 89–115). Praeger.

Guba, E. G., & Lincoln, Y. S. (1994). Competing Paradigms in Qualitative Research. *Handbook of Qualitative Research*, 105–117. https://doi.org/http://www.uncg.edu/hdf/facultystaff/Tudge/Guba%20&%20Lincoln%201994.pdf

Gund, A., Sjöqvist, B. A., Wigert, H., Hentz, E., Lindecrantz, K., & Bry, K. (2013). A randomized controlled study about the use of eHealth in the home health care of premature infants. *BMC Medical Informatics and Decision Making*, *13*(1). https://doi.org/10.1186/1472-6947-13-22

Hanmer, L. a, Roode, J. D., & Isaacs, S. (2007). Modelling the effect of limited or vulnerable resources on the use of computerised hospital information systems (CHISs) in South Africa. *Studies in Health Technology and Informatics*, *130*, 299–

309.

Haq, M., Numekevor, L., Singh, P., & Chisholm, A. (2015). *Community Health Profile : Southwestern Ontario*. https://www.swahn.ca/uploads/contentdocuments/cc license - community health profile for southwestern ontario .pdf

Health Canada. (2012a). *Canada's Health Infostructure*. http://www.hc-sc.gc.ca/hcs-sss/ehealth-esante/infostructure/hist-eng.php

Health Canada. (2012b). *Health Care System - Primary Health Care*. http://www.hc-sc.gc.ca/hcs-sss/prim/index-eng.php

Health Metrics Network. (2008). Assessing the National Health Information System An Assessment Tool. *Health San Francisco*, 1–73. https://doi.org/978 92 4 154751 2

Healthcare Information Management Systems Society. (n.d.). *HIMSS Analytics*. Retrieved July 2, 2020, from https://www.himssanalytics.org

Hertle, D., & Stock, S. (2015). Commonwealth Fund Survey 2012: Survey of Primary Care Doctors in 11 Countries: Use of Health Information Technology and Important Aspects of Care. *GESUNDHEITSWESEN*, *77*(8–9), 542–549. https://doi.org/10.1055/s-0035-1549941

Hesse-Biber, S., & Johnson, R. B. (2013). Coming at Things Differently: Future Directions of Possible Engagement With Mixed Methods Research. *Journal of Mixed Methods Research*, *7*(2), 103–109. https://doi.org/10.1177/1558689813483987

Hesse, B. W., & Shneiderman, B. (2007). eHealth Research from the User's Perspective. *American Journal of Preventive Medicine*, *32*(5 SUPPL.).

https://doi.org/10.1016/j.amepre.2007.01.019

HIMSS Analytics. (2009). *EMR Adoption Model (EMRAM)*. http://www.himssanalytics.org/provider-solutions

HIMSS Health Information and Management Systems Society. (2013). *What is Interoperability?* http://www.himss.org/library/interoperability-standards/what-is-interoperability

Holloway, I., & Todres, L. (2003). The Status of Method: Flexibility, Consistency and Coherence. *Qualitative Research*. https://doi.org/10.1177/1468794103033004

Holton, J. A. (2010). The Coding Process and Its Challenges. *Grounded Theory Review*, *9*(1), 21–40. https://doi.org/I: http://dx.doi.org/10.4135/9781848607941.n13

Holton, J. A., & Walsh, I. (2020). Classic Grounded Theory: Applications With Qualitative and Quantitative Data. *Classic Grounded Theory: Applications With Qualitative and Quantitative Data*, *January*. https://doi.org/10.4135/9781071802762

House, E. R. (1980). *Evaluating with Validity*. Sage Publications.

Hsieh, P.-J. (2014). Physicians' acceptance of electronic medical records exchange: An extension of the decomposed TPB model with institutional trust and perceived risk. *International Journal of Medical Informatics*, *June*, 1–14. https://doi.org/10.1016/j.ijmedinf.2014.08.008

IBM. (2017). *IBM SPSS Statistics Software for Windows, Version 25*. IBM. https://doi.org/10.1016/j.jchf.2014.02.009

IBM. (2019). *KMO and Bartlett's Test*. IBM Knowledge Center.

ICTC Information and Communications Technology Council. (2009). *eHealth in Canada: Current Trends and Future Challenges*. *April*. http://www.ictc-ctic.ca/wp-content/uploads/2012/06/ICTC_eHealthSitAnalysis_EN_04-09.pdf

Institute for Safe Medication Practices Canada. (2018). *Electronic Prescribing in Primary Care: Effects on Medication Safety*. 1–6. www.ismp-canada.org/err_index.htm

Institute of Medicine. (1994). Defining Primary Care. *National Academies Press*. http://www.nap.edu/read/9153/chapter/2

Ivankova, N. V., Creswell, J. W., & Stick, S. L. (2006). Using Mixed-Methods Sequential Explanatory Design: From Theory to Practice. *Field Methods*. https://doi.org/10.1177/1525822X05282260

Jackson, R. A. (1980). Interpretation of research data: selected statistical procedures. *American Journal of Hospital Pharmacy*. https://doi.org/10.1093/ajhp/37.12.1673

Jaspers, M. W., Peute, L. W., Lauteslager, A., & Bakker, P. J. (2008). Pre-post evaluation of physicians satisfaction with redesigned electroni medical records system. *Stud Health Technol Inform*. https://doi.org/10.1016/j.nima.2016.12.001

Jeske, H. C., Lederer, W., Lorenz, I., Kolbitsch, C., Margreiter, J., Kinzl, J., & Benzer, A. (2001). The impact of business cards on physician recognition after general anesthesia. *Anesthesia and Analgesia*. https://doi.org/10.1097/00000539-200111000-00045

Johnson, R. B., Onwuegbuzie, A. J., & Turner, L. A. (2007). Toward a Definition of Mixed Methods Research. *Journal of Mixed Methods Research*.

https://doi.org/10.1177/1558689806298224

Johnson, R. Burke, & Onwuegbuzie, A. J. (2004). Mixed Methods Research: A Research Paradigm Whose Time Has Come. *Educational Researcher*, *33*(7), 14–26. https://doi.org/10.3102/0013189X033007014

Jones, M., Koziel, C., Larsen, D., Berry, P., & Kubatka-Willms, E. (2017). Progress in the Enhanced Use of Electronic Medical Records: Data From the Ontario Experience. *JMIR Medical Informatics*. https://doi.org/10.2196/medinform.6928

Jupp, V. (2006). The SAGE Dictionary of Social Research Methods [electronic resource]. In *SAGE DICTIONARY OF SOCIAL RESEARCH METHODS*.

Kaiser, M. O. (1974). Kaiser-Meyer-Olkin measure for identity correlation matrix. *Journal of the Royal Statistical Society*.

Katz, S. J., Nissan, N., & Moyer, C. A. (2004). Crossing the digital divide: Evaluating online communication between patients and their providers. *American Journal of Managed Care*. https://doi.org/2677 [pii]

Kazley, A. S., Diana, M. L., & Menachemi, N. (2011). The agreement and internal consistency of national hospital EMR measures. *Health Care Management Science*. https://doi.org/10.1007/s10729-011-9165-8

Kerlinger, F. N. (1973). Foundation of Behavioural Research. *American Journal of Educational Research*. https://doi.org/10.12691/education-2-1-6

Khandelwal, V. K., & Ferguson, J. R. (1999). Critical Success Factors (CSFs) and the Growth of IT in Selected Geographic Regions University of Western Sydney University of Western Sydney. *Sciences-New York*, *00*(c), 1–13.

https://doi.org/10.1109/HICSS.1999.772760

Kierkegaard, P. (2015). Governance structures impact on eHealth. *Health Policy and Technology*, *4*(1), 39–46. https://doi.org/10.1016/j.hlpt.2014.10.016

Koelsch, L. E. (2013). Reconceptualizing the member check interview. *International Journal of Qualitative Methods*. https://doi.org/10.1177/160940691301200105

Kreps, G. L., & Neuhauser, L. (2010). New directions in eHealth communication: Opportunities and challenges. *Patient Education and Counseling*, *78*(3), 329–336. https://doi.org/10.1016/j.pec.2010.01.013

Krist, A. H., Woolf, S. H., Bello, G. A., Sabo, R. T., Longo, D. R., Kashiri, P., Etz, R. S., Loomis, J., Rothemich, S. F., Eric Peele, J., & Cohn, J. (2014). Engaging primary care patients to use a patient-centered personal health record. *Annals of Family Medicine*. https://doi.org/10.1370/afm.1691

Krist, A. H., Beasley, J. W., Crosson, J. C., Kibbe, D. C., Klinkman, M. S., Lehman C. U., Fox, C. H., Mitchell, J. M., Mold, J. W., Pace. W. D., Peterson, K. A., Phillips, R. L., Post, R., Puro, J., Raddock, M., Simkus, R., Waldren, S. E. (2014). Electronic health record functionality needed to better support primary care. *Journal of American Medical Informatics Association, 21(5), 764-771*. https://doi.org/ 10.1136/amiajnl-2013-002229

Kuo, M.-H., Kushniruk, A. W., Borycki, E. M., Hsu, C.-Y., & Lai, C.-L. (2011). National strategies for health data interoperability. *Studies in Health Technology and Informatics*, *164*, 238–242. https://doi.org/10.3233/978-1-60750-709-3-238

Larsen, D. (2015). Hospital Report Manager: Expansion and Success. *Ontario Medical*

Review, *August*, 1–2. https://www.ontariomd.ca/articlesdocumentlibrary/emr-approved-j sgl pages.pdf

Larsen, D. (2019). Insights4Care Program brings your EMR data to life for better patient outcomes : *Ontario Medical Review*, *December*.

Lau, F, Price, M., & Bassi, J. (2014). Toward a coordinated electronic health record (EHR) strategy for Canada. *Creating Strategic Change In Canadian*, 35–45. https://smith.queensu.ca/centres/monieson/knowledge_articles/2014WhitePaper_v16SmallestFileSize.pdf#page=35

Lau, Francis. (2009). Extending the infoway benefits evaluation framework for health information systems. *Studies in Health Technology and Informatics*, *143*, 406–413. https://doi.org/10.3233/978-1-58603-979-0-406

Lau, Francis, Hagens, S., & Muttitt, S. (2007a). A proposed benefits evaluation framework for health information systems in Canada. *Healthcare Quarterly (Toronto, Ont.)*, *10*(1), 112–116, 118.

Lau, Francis, Hagens, S., & Muttitt, S. (2007b). A Proposed Benefits Evaluation Framework for Health Information Systems in Canada. *Healthcare Quarterly*, *10*(1), 112–118.

Lau, Francis, Kuziemsky, C., Price, M., & Gardner, J. (2010). A review on systematic reviews of health information system studies. *Journal of the American Medical Informatics Association : JAMIA*, *17*(6), 637–645. https://doi.org/10.1136/jamia.2010.004838

Lau, Francis, Price, M., Boyd, J., Partridge, C., Bell, H., & Raworth, R. (2012). Impact of electronic medical record on physician practice in office settings: a systematic review. In *BMC Medical Informatics and Decision Making* (Vol. 12, Issue 1, p. 10). https://doi.org/10.1186/1472-6947-12-10

Lau, Francis, Price, M., & Keshavjee, K. (2011). From benefits evaluation to clinical adoption: making sense of health information system success in Canada. *Healthcare Quarterly (Toronto, Ont.), 14*(1), 39–45. https://doi.org/10.12927/hcq.2011.22157

Lemire, F. (2019). *Refreshing the Patient's Medical Home*. *65*(2), 2503. http://www.cfp.ca/content/cfp/65/2/152.full.pdf

Lingard, L., Albert, M., Levinson, W., John, S., & Eaton, Lady. (2008). Grounded theory, mixed methods, and action research. *British Medical Journal*. https://doi.org/10.1136/bmj.39602.690162.47

Lodico, M. G., Spaulding, D. T., & Voegtle, K. H. (2006). Methods in educational research : from theory to practice. *John Wiley & Sons*.

Ludwick, D. A., & Doucette, J. (2009). Adopting electronic medical records in primary care: Lessons learned from health information systems implementation experience in seven countries. *International Journal of Medical Informatics*, *78*(1), 22–31. https://doi.org/10.1016/j.ijmedinf.2008.06.005

Ludwick, D., Manca, D., & Doucette, J. (2010). Primary care physicians' experiences with electronic medical records: Implementation experience in community, urban, hospital, and academic family medicine. *Canadian Family Physician, 56*(1).

Lyles, C. R., Allen, J. Y., Poole, D., Tieu, L., Kanter, M. H., & Garrido, T. (2016). "I want to keep the personal relationship with my doctor": Understanding barriers to portal use among african americans and latinos. *Journal of Medical Internet Research*. https://doi.org/10.2196/jmir.5910

Machan, C., Ammenwerth, E., & Schabetsberger, T. (2006). Evaluation of the electronic transmission of medical findings from hospitals to practitioners by triangulation. *Methods of Information in Medicine*, *45*(2), 225–233. https://doi.org/10.1267/METH06020225

Mäenpää, T., SuoMäenpää, T., Suominen, T., Asikainen, P., Maass, M., & Rostila, I. (2009). The outcomes of regional healthcare information systems in health care: a review of the research literature. International Journal of Medical Informatics, 78(11), 757–71. doi:10, T., Asikainen, P., Maass, M., & Rostila, I. (2009). The outcomes of regional healthcare information systems in health care: a review of the research literature. *International Journal of Medical Informatics*, *78*(11), 757–771. https://doi.org/10.1016/j.ijmedinf.2009.07.001

Majeed, A., Car, J., & Sheikh, A. (2008). Accuracy and completeness of electronic patient records in primary care. *Family Practice*, *25*(4), 213–214. https://doi.org/10.1093/fampra/cmn047

Marchildon, G. (2014). *Health Systems in Transition: Canada, 2nd edition* (Issue June 2013). http://www.euro.who.int/__data/assets/pdf_file/0009/80568/E87954.pdf

Mattli, W. (2012). Comparative Regional Integration: Theoretical Developments. In *The Oxford Handbook of European Integration* (Issue February 2016, pp. 1–20). https://doi.org/10.1093/oxfordhb/9780199546282.013.0054

McCarthy, D. B., Propp, K., Cohen, A., Sabharwal, R., Schachter, A. A., & Rein, A. L. (2014). Learning from Health Information Exchange Technical Architecture and

Implementation in Seven Beacon Communities. *EGEMs (Generating Evidence & Methods to Improve Patient Outcomes)*, *2*(1), 6. https://doi.org/10.13063/2327-9214.1060

McGinn, C. A., Grenier, S., Duplantie, J., Shaw, N., Sicotte, C., Mathieu, L., Leduc, Y., Légaré, F., & Gagnon, M. P. (2011). Comparison of user groups' perspectives of barriers and facilitators to implementing electronic health records: A systematic review. *BMC Medicine*. https://doi.org/10.1186/1741-7015-9-46

McKight, P. E., & Najab, J. (2010). Kruskal-Wallis Test. In *The Corsini Encyclopedia of Psychology*. https://doi.org/10.1002/9780470479216.corpsy0491

McMurray, J., Hicks, E., Johnson, H., Elliott, J., Byrne, K., & Stolee, P. (2013). "Trying to find information is like hating yourself every day": The collision of electronic information systems in transition with patients in transition. *Health Informatics Journal*. https://doi.org/10.1177/1460458212467547

McWhinney, I. (1969). The Foundations of Family Medicine. *Canadian Family Physician*, *15*(4), 13–15. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2281357/?page=1

McWhinney, I. R. (1998). *Primary Care : Core Values in a Changing World*. *1809*, 1807–1809.

Middleton, B., Bloomrosen, M., Dente, M. A., Hashmat, B., Koppel, R., Overhage, J. M., Payne, T. H., Rosenbloom, S. T., Weaver, C., Zhang, J., & American Medical Informatics, A. (2013). Enhancing patient safety and quality of care by improving the usability of electronic health record systems: recommendations from AMIA. *J Am Med Inform Assoc*, *20*(e1), e2-8. https://doi.org/10.1136/amiajnl-2012-001458

Miller, D., Noonan, K., Fiks, A. G., & Lehmann, C. U. (2015). Increasing Pediatrician Participation in EHR Incentive Programs. *PEDIATRICS*, *135*(1), e1–e4. https://doi.org/10.1542/peds.2014-2438

Miller, D. P., Latulipe, C., Melius, K. A., Quandt, S. A., & Arcury, T. A. (2016). Primary Care Providers' Views of Patient Portals: Interview Study of Perceived Benefits and Consequences. *Journal of Medical Internet Research*. https://doi.org/10.2196/jmir.4953

Miller, R. H., & Sim, I. (2004). Physicians' use of electronic medical records: Barriers and solutions. *Health Affairs*, *23*, 116–126. https://doi.org/DOI 10.1377/hlthaff.23.2.116

Misha Kay, Santos, J., & Takane, M. (2011). Global Observatory for eHealth: Atlas: eHealth country profiles. *Global Observatory for EHealth Series*, *1*. http://whqlibdoc.who.int/publications/2011/9789241564168_eng.pdf

Monte, A. A., Anderson, P., Hoppe, J. A., Weinshilboum, R. M., Vasiliou, V., & Heard, K. J. (2015). Accuracy of electronic medical record medication reconciliation in emergency department patients. *Journal of Emergency Medicine*, *49*(1), 78–84. https://doi.org/10.1016/j.jemermed.2014.12.052

Moore, Z., Angel, D., Bjerregaard, J., O'Connor, T., McGuiness, W., Kröger, K., Rasmussen, B. S. B., & Yderstrœde, K. B. (2015). eHealth in Wound Care: from conception to implementation. *Journal of Wound Care*. https://doi.org/10.12968/jowc.2015.24.sup5.s1

Morse, L., & Richards, J. (2007). *Read me first for a users guide to qualitative methods* (2nd ed.). Sage.

Mulenga, G. (2013). Regional Integration Brief. *Regional Integration Brief*, *1*, 1–12.

Neuhauser, L., Kreps, G. L., Morrison, K., Athanasoulis, M., Kirienko, N., & Van Brunt, D. (2013). Using design science and artificial intelligence to improve health communication: ChronologyMD case example. *Patient Education and Counseling*, *92*(2), 211–217. https://doi.org/10.1016/j.pec.2013.04.006

Newell, S., & David, G. (2012). Challenges of coordination using electronic health records: A genre analysis. *ECIS 2012 - Proceedings of the 20th European Conference on Information Systems*.

Newswire, C. (2013). Nightingale is the first EMR provider in Canada to partner with PEPID and the Canadian Pharmacists Association to improve prescription and drug safety. In *Nightingale-Partners*.

NHS. (2011). *NHS Infrastructure Maturity Model*. NHS DIGITAL. http://systems.digital.nhs.uk/nimm

Nightingale Informatix Corporation. (n.d.). *Nightingale EMR*. Retrieved January 23, 2019, from https://en.wikipedia.org/wiki/Nightingale_Informatix_Corporation

Nøhr, C., Kristensen, M., Andersen, S. K., Vingtoft, S., Lippert, S., Bernstein, K., & Bruun-Rasmussen, M. (2001). Shared experience in 13 local Danish EPR projects: The Danish EPR observatory. *Studies in Health Technology and Informatics*. https://doi.org/10.3233/978-1-60750-928-8-670

Nolan, R. (1973). Managing the computer resource: a stage hypothesis. *Communications of the ACM*, *16*(7), 399–405. https://doi.org/10.1145/362280.362284

Nykanen, P., & Karimaa, E. (2006). Success and failure factors in the regional health information system design process - Results from a constructive evaluation study. *METHODS OF INFORMATION IN MEDICINE*, *45*(1), 85–89. http://apps.isiknowledge.com/full_record.do?product=WOS&search_mode=GeneralSearch&qid=56&SID=Q2KF9PPJ3Fkio@dDG31&page=1&doc=1

O'Malley, A. S., Grossman, J. M., Cohen, G. R., Kemper, N. M., & Pham, H. H. (2010). Are electronic medical records helpful for care coordination? Experiences of physician practices. *Journal of General Internal Medicine*. https://doi.org/10.1007/s11606-009-1195-2

Oake, J., Aref-Eshghi, E., Godwin, M., Collins, K., Aubrey-Bassler, K., Duke, P., Mahdavian, M., & Asghari, S. (2017). Using Electronic Medical Record to Identify Patients With Dyslipidemia in Primary Care Settings: International Classification of Disease Code Matters From One Region to a National Database. *Biomedical Informatics Insights*, *9*(May), 117822261668588. https://doi.org/10.1177/1178222616685880

Oh, C. H., & Rugman, A. M. (2012). Regional integration and the international strategies of large European firms. *International Business Review*, *21*(3), 493–507. https://doi.org/10.1016/j.ibusrev.2011.05.009

Oh, H., Rizo, C., Enkin, M., & Jadad, A. (2005). What is eHealth (3): A systematic review of published definitions. In *Journal of Medical Internet Research* (Vol. 7, Issue 1). https://doi.org/10.2196/jmir.7.1.e1

Oktay, J. S. (2012). Grounded theory. *Pocket Guides to Social Work Research Methods*, 1–5. https://shibboleth2sp.sams.oup.com/Shibboleth.sso/Login?entityID=https://lse.ac.uk/idp&target=https://shibboleth2sp.sams.oup.com/shib?dest=http://www.oxfordschol

arship.com/SHIBBOLETH?dest=http://dx.doi.org/10.1093/acprof:oso/9780199753697.001.0001

Ontario Ministry of Health and Long Term Care. (n.d.). *Primary Care Payment Models in Ontario*. Ontario Ministry of Health and Long Term Care. Retrieved July 8, 2013, from http://www.health.gov.on.ca/en/pro/programs/pcpm/

Ontario Ministry of Health and Long Term Care. (2004). *Ontario Laboratories Information System and Your Health Records*. 99. http://www.health.gov.on.ca/en/news/bulletin/2010/docs/patient_info_sheet.pdf

Ontario Office of Chief Medical Informatics Officer. (2015). *Benefits Realization Update 2015 Office of the CMIO* (Issue August). https://collections.ola.org/mon/29009/331934.pdf

OntarioMD. (n.d.-a). *OntarioMD Certified EMR Offerings*. Retrieved August 7, 2018, from https://www.ontariomd.ca/emr-certification/certified-emr-offerings

OntarioMD. (n.d.-b). *OntarioMD Maturity Model*. Retrieved January 2, 2020, from https://wwwtest.nonprod.ontariomd.ca/products-and-services/emr-progress-assessment/emr-maturity-model

OntarioMD. (2004). *OntarioMD Case Study : Harnessing the power of EMRs for e ective cancer care follow-up*. https://www.ontariomd.ca/documents/peer leader program/peer leader case study-v2.pdf

OntarioMD. (2012). *Ontario MD EMR Maturity Model*. https://www.ontariomd.ca

OntarioMD. (2015). *CORE EMR SPECIFICATION Section 1 : EMR Baseline Requirements*. 1–83.

OntarioMD. (2017). *EMR AND DATA MIGRATION GUIDE*.

Osterhof, A. (2001). *Classroom applications of educational measurement*. Prentice Hall.

Owens, B. (2018). Family doctors call for guaranteed access to EMR data for research and quality improvement. *CMAJ : Canadian Medical Association Journal = Journal de l'Association Medicale Canadienne*, *190*(2), E60–E61. https://doi.org/10.1503/cmaj.109-5543

Pagliari, C. (2007). Design and evaluation in ehealth: Challenges and implications for an interdisciplinary field. *Journal of Medical Internet Research*, *9*(2). https://doi.org/10.2196/jmir.9.2.e15

Patrick, K. (2014). Patients and their medical records: It is time to embrace transparency. *CMAJ : Canadian Medical Association Journal = Journal de l'Association Medicale Canadienne*, *186*(11), 811. https://doi.org/10.1503/cmaj.140834

Patton, M. Q. (2002). Qualitative research and evaluation methods. In *Qualitative Inquiry* (Vol. 3rd). https://doi.org/10.2307/330063

Payne, E. (2019, March 15). Ontario begins dismantling local health integration system. *The Ottawa Citizen*. https://ottawacitizen.com/news/politics/ontario-begins-dismantling-local-health-integration-system

Perry, J. J., Sutherland, J., Symington, C., Dorland, K., Mansour, M., & Stiell, I. G. (2014). Assessment of the impact on time to complete medical record using an electronic medical record versus a paper record on emergency department patients: A study. *Emergency Medicine Journal*. https://doi.org/10.1136/emermed-2013-202479

Perzynski, A. T., Roach, M. J., Shick, S., Callahan, B., Gunzler, D., Cebul, R., Kaelber, D. C., Huml, A., Thornton, J. D., & Einstadter, D. (2017). Patient portals and broadband internet inequality. *Journal of the American Medical Informatics Association*. https://doi.org/10.1093/jamia/ocx020

Peute, L. W., Aarts, J., Bakker, P. J. M., & Jaspers, M. W. M. (2010). Anatomy of a failure: A sociotechnical evaluation of a laboratory physician order entry system implementation. *International Journal of Medical Informatics*, *79*(4). https://doi.org/10.1016/j.ijmedinf.2009.06.008

Philip, L., Roberts, A., Currie, M., & Mort, A. (2015). Technology for Older Adults: Maximising Personal and Social Interaction: Exploring Opportunities for eHealth to Support the Older Rural Population with Chronic Pain. *Scottish Geographical Journal*, *131*(3–4), 181–193. https://doi.org/10.1080/14702541.2014.978806

Powers, P. (2009). Canada's e-health journey and HIMSS Analytics' Canada Information and Communications Technology Study. *Healthcare Quarterly (Toronto, Ont.)*, *12*(1), 120–122, 4.

Price, M., Lau, F., & Lai, J. (2011). Measuring EMR Adoption: A Framework and Case Study. *ElectronicHealthcare*. https://doi.org/10.1186/1472-6947-14-43

Price, M., Singer, A., & Kim, J. (2013a). Adopting electronic medical records: Are they just electronic paper records? *Canadian Family Physician*, *59*(7).

Price, M., Singer, A., & Kim, J. (2013b). Adopting electronic medical records: Are they just electronic paper records? *Canadian Family Physician*. https://doi.org/59/7/e322 [pii]

PricewaterhouseCoopers. (2015). *EMR Benefits Realization Study Update*. *August*. https://www.ehealthontario.on.ca/images/uploads/pages/documents/EMR_Benefits_Realization_Study_Update_English.pdf

Protti, D. (2007). Comparison of information technology in general practice in 10 countries. *Healthcare Quarterly (Toronto, Ont.)*, *10*(2), 107–116.

Protti, D. (2008). US Regional Health Information Organizations and the Nationwide Health Information Network: Any Lessons for Canadians? *ElectronicHealthcare*, *6*(4), 96–103. http://www.longwoods.com/product/19625

Protti, D., & Johansen, I. (2010). Widespread adoption of information technology in primary care physician offices in Denmark: a case study. *Issue Brief (Commonwealth Fund)*, *80*(March), 1–14.

QHR Technologies. (2019). *Accuro EMR*. https://accuroemr.com/emr-software/

QSR International Pty Ltd. (2015). What is NVivo? *Www.Qsrinternational.Com*. https://doi.org/10.1016/j.bbapap.2010.04.001.Molecular

Rossi, P., Freeman, H., & Lipsey, M. (1999). Evaluation a systemic Approach. In *Evaluation a systemic Approach*.

ROTHBAUER, K. (2020). Mustimuhw makes big step in e-prescriptions. *Cowichan Valley Citizen (Duncan, BC)*.

Rothgeb, J. M., Willis, G., & Forsyth, B. (2007). Questionnaire Pretesting Methods. *Bulletin of Sociological Methodology*.

Rozenblum, R., Jang, Y., Zimlichman, E., Salzberg, C., Tamblyn, M., Buckeridge, D., Forster, A., Bates, D. W., & Tamblyn, R. (2011a). A qualitative study of Canada's experience with the implementation of electronic health information technology. *Canadian Medical Association Journal*, *183*(5), E281–E288. https://doi.org/10.1503/cmaj.100856

Rozenblum, R., Jang, Y., Zimlichman, E., Salzberg, C., Tamblyn, M., Buckeridge, D., Forster, A., Bates, D. W., & Tamblyn, R. (2011b). A qualitative study of Canada's experience with the implementation of electronic health information technology. *Canadian Medical Association Journal*, *183*(5), 281–288. https://doi.org/10.1503/cmaj.100856

Rubel, P., Fayn, J., Nollo, G., Assanelli, D., Li, B., Restier, L., Adami, S., Arod, S., Atoui, H., Ohlsson, M., Simon-Chautemps, L., Télisson, D., Malossi, C., Ziliani, G. L., Galassi, A., Edenbrandt, L., & Chevalier, P. (2005). Toward personal eHealth in cardiology. Results from the EPI-MEDICS telemedicine project. *Journal of Electrocardiology*. https://doi.org/10.1016/j.jelectrocard.2005.06.011

Salzberg, C. A., Jang, Y., Rozenblum, R., Zimlichman, E., Tamblyn, R., & Bates, D. W. (2012). Policy initiatives for Health Information Technology: A qualitative study of U.S. expectations and Canada's experience. *International Journal of Medical Informatics*, *81*(10), 713–722. https://doi.org/10.1016/j.ijmedinf.2012.07.007

SAS Institute. (2012). SAS version 9.4. In *SAS Institute Inc.*

Scheingold, L., & Lindberg, S. (1971). *Regional Integration: Theory and Research*. Harvard University Press.

Schiaffini, R., Tagliente, I., Carducci, C., Ullmann, N., Ciampalini, P., Lorubbio, A., & Cappa, M. (2016). Impact of long-term use of eHealth systems in adolescents with type 1 diabetes treated with sensor-augmented pump therapy. *Journal of Telemedicine and Telecare*, *22*(5), 277–281. https://doi.org/10.1177/1357633X15598425

Schiff, M., & Winters, L. A. (2003). Regional Integration and Development. In *Integration The Vlsi Journal* (Vol. 82, Issue 5). https://doi.org/10.2307/20033699

Schmitter, P. C. (1970). A Revised Theory of Regional Integration. *International Organization*, *24*(4), 836–868. https://doi.org/10.1017/S0020818300017549

Schnelker, D. (2006). The student as bricoleur: Making sense of research paradigms. *Teaching and Teacher Education*, *22*, 42–57.

Scott's Directories. (2016). *CANADIAN MEDICAL DIRECTORY*. http://mdselect.ca/

Sempeles, S. (2014). Kaiser Permanente: Technology drives changes in infrastructure and design. *Journal of Clinical Engineering*. https://doi.org/10.1097/jce.0000000000000014

Shamoo, A. E., & Resnik, D. B. (2009). Responsible Conduct of Research. In *Responsible Conduct of Research*. https://doi.org/10.1093/acprof:oso/9780195368246.001.0001

Shamoo, & Resnik. (2015). Responsible conduct of research. In *African Health Sciences* (Vol. 18, Issue 1). https://doi.org/10.4314/ahs.v18i1.25

Sharma, B. (2008). * Electronic Healthcare Maturity Model. *Quintegra Solutions*, *June*. http://www.quintegrasolutions.com/eHMM White Paper.pdf

Shaw, N. T. (2002). "CHEATS": A generic information communication technology

(ICT) evaluation framework. In *Computers in Biology and Medicine* (Vol. 32, Issue 3, pp. 209–220). https://doi.org/10.1016/S0010-4825(02)00016-1

Shortliffe, E. H., & Cimino, J. J. (2014). Biomedical informatics: Computer applications in health care and biomedicine: Fourth edition. In *Biomedical Informatics: Computer Applications in Health Care and Biomedicine: Fourth Edition*. https://doi.org/10.1007/978-1-4471-4474-8

Silvestre, A. L., Sue, V. M., & Allen, J. Y. (2009). If you build it, will they come? The kaiser permanente model of online health care. *Health Affairs*, *28*(2), 334–344. https://doi.org/10.1377/hlthaff.28.2.334

Smart Systems for Health Agency. (2005). *Making e-health a reality: Smart Systems for Health Agency annual report : April 1, 2004 to March 31, 2005*. http://alpha.lib.uwo.ca/record=b4492761

Song, W., Tjondronegoro, D., & Docherty, M. (2012). Understanding User Experience of Mobile Video: Framework, Measurement, and Optimization. In *Mobile Multimedia - User and Technology Perspectives*. https://doi.org/10.5772/39053

Staggers, N., & Rodney, M. (2012). Promoting usability in organizations with a new health usability model: implications for nursing informatics. *NI 2012 : 11th International Congress on Nursing Informatics, June 23-27, 2012, Montreal, Canada. International Congress in Nursing Informatics (11th : 2012 : Montreal, Quebec) Author*, *2012*, 396.

Starfield B. (1998). *Primary Care: Balancing Health Needs, Services and Technology*. New York: Oxford University Press.

Statistics Canada. (2010a). *Questionnaire Design*. Survey Steps. https://www150.statcan.gc.ca/n1/pub/12-539-x/2009001/design-conception-eng.htm

Statistics Canada. (2010b). *Survey Methods and Practices* (Catalogue). Statistics Canada. https://doi.org/10.18848/1447-9524/cgp/v10i01/49872

Statistics Canada. (2016). *Data products, 2016 Census*. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/index-eng.cfm

Statistics Canada. (2017). *Health Profile Ontario*. https://www12.statcan.gc.ca/health-sante/82-228/search-recherche/lst/page.cfm?Lang=E&GeoLevel=PR&GEOCODE=35

Statistics How To. (2016). Kaiser-Meyer-Olkin (KMO) Test for Sampling Adequacy. In *Stephanie Glen*., Elementary Statistics for the rest of us. Retrieved from https://www.statisticshowto.com/kaiser-meyer-olkin/

Steele Gray, C., Miller, D., Kuluski, K., & Cott, C. (2014). Tying eHealth Tools to Patient Needs: Exploring the Use of eHealth for Community-Dwelling Patients With Complex Chronic Disease and Disability. *JMIR Research Protocols*, *3*(4), e67. https://doi.org/10.2196/resprot.3500

Strauss, A., & Corbin, J. (2008). Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory. In *Basics of Qualitative Research Grounded Theory Procedures and Techniques* (Vol. 3). https://doi.org/10.4135/9781452230153

Streiner, D. L. (2003). An introduction to Coefficient Alpha and Internal Consistency. *Journal of Personality Assessment*. https://doi.org/10.1207/S15327752JPA8001

Strudwick, G., Booth, R. G., Bjarnadottir, R. I., Collins, S., & Srivastava, R. (2017). Exploring the role of the nurse manager in supporting point-of-care nurses' adoption of electronic health records: Protocol for a qualitative research study. *BMJ Open*, *7*(10), 1–6. https://doi.org/10.1136/bmjopen-2017-018129

Sujansky, W. (2001). Heterogeneous database integration in biomedicine. *Journal of Biomedical Informatics*, *34*(2001), 285–298. https://doi.org/10.1006/jbin.2001.1024

Sweet, L. E., & Moulaison, H. L. (2013). Electronic health records data and metadata: Challenges for big data in the United States. *Big Data*. https://doi.org/10.1089/big.2013.0023

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. In *International journal of medical education*. https://doi.org/10.5116/ijme.4dfb.8dfd

Teddlie, C., & Tashakkori, A. (2003). Major Issues and Controversies in the Use of Mixed Methods in the Social and Behavioural Sciences. In *Handbook of Mixed Methods in Social & Behavioral Research* (pp. 3–50).

Telus Health. (2019). *Telus Practice Solutions PS Suite EMR*. https://www.telus.com/en/health/health-professionals/clinics/ps-suite

Tennis, J. T. (2008). Epistemology, theory, and methodology in knowledge organization: Toward a classification, metatheory, and research framework. *Knowledge Organization*. https://doi.org/10.5771/0943-7444-2008-2-3-102

Terry, A. L., Stewart, M., Fortin, M., Wong, S. T., Grava-Gubins, I., Ashley, L., Sullivan-Taylor, P., Sullivan, F., Zucker, L., & Thind, A. (2016). Stepping Up to the Plate: An Agenda for Research and Policy Action on Electronic Medical Records in

Canadian Primary Healthcare. *Healthcare Policy = Politiques de Sante*, *12*(2), 19–32.

Terry, A. L., Stewart, M., Fortin, M., Wong, S. T., Kennedy, M., Burge, F., Birtwhistle, R., Grava-Gubins, I., Webster, G., & Thind, A. (2012). How does Canada stack up? A bibliometric analysis of the primary healthcare electronic medical record literature. *Informatics in Primary Care*. https://doi.org/10.14236/jhi.v20i4.2

The Commonwealth Fund. (2012). *The Commonwealth Fund 2012 International Health Policy Survey of Primary Care Physicians*. https://www.commonwealthfund.org/publications/surveys/2012/nov/2012-commonwealth-fund-international-survey-primary-care-doctors

The Commonwealth Fund. (2015). *2015 Commonwealth Fund International Survey of Primary Care Physicians in 10 Nations*. https://www.commonwealthfund.org/publications/surveys/2015/dec/2015-commonwealth-fund-international-survey-primary-care-physicians

Thomas, D. R. (2017). Feedback from research participants: are member checks useful in qualitative research? *Qualitative Research in Psychology*. https://doi.org/10.1080/14780887.2016.1219435

Thompson, S. K. (2012). Sampling, Third Edition. In *Sampling, Third Edition*. https://doi.org/10.1002/9781118162934

Thorne, S., Stephens, J., & Truant, T. (2016). Building qualitative study design using nursing's disciplinary epistemology. *Journal of Advanced Nursing*. https://doi.org/10.1111/jan.12822

Tracy, S. J. (2010). Qualitative Quality: Eight “Big-Tent” Criteria for Excellent Qualitative Research. In *Qualitative Inquiry* (Vol. 16, Issue 10, pp. 837–851). https://doi.org/10.1177/1077800410383121

Triska, O. H., Church, J., Wilson, D., Roger, R., Johnston, R., Brown, K., & Noseworthy, T. W. (2005). Physicians’ Perceptions of Integration in Three Western Canada Health Regions. *Healthcare Management Forum*, *18*(3), 18–24. https://doi.org/10.1016/S0840-4704(10)60364-X

van der Heijden, M., Lucas, P. J. F., Lijnse, B., Heijdra, Y. F., & Schermer, T. R. J. (2013). An autonomous mobile system for the management of COPD. *Journal of Biomedical Informatics*. https://doi.org/10.1016/j.jbi.2013.03.003

Van Der Meijden, M. J., Tange, H. J., Troost, J., & Hasman, A. (2003). Determinants of success of inpatient clinical information systems: A literature review. In *Journal of the American Medical Informatics Association* (Vol. 10, Issue 3, pp. 235–243). https://doi.org/10.1197/jamia.M1094

Van Gijseghem, H., & Vaughn, K. J. (2008). Regional integration and the built environment in middle-range societies: Paracas and early Nasca houses and communities. *Journal of Anthropological Archaeology*, *27*(1), 111–130. https://doi.org/10.1016/j.jaa.2007.11.002

VandeVen, & Ferry, D. (1980). *Measuring and Assessing Organizations*. Wiley.

Vest, J. R., & Jasperson, J. (2010). What should we measure? Conceptualizing usage in health information exchange. *Journal of the American Medical Informatics Association : JAMIA*, *17*(3), 302–307. https://doi.org/10.1136/jamia.2009.000471

Wager, K. A., Lee, F. W., White, A. W., Ward, D. M., & Ornstein, S. M. (2000). Impact of an electronic medical record system on community-based primary care practices. *Journal of the American Board of Family Practice*.

Webster, P. C. (2011a). National electronic health information strategy needs to be refocused, critics say. In *CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne* (Vol. 183, Issue 1, pp. 32–33). https://doi.org/10.1503/cmaj.109-3744

Webster, P. C. (2011b). Ontario survey indicates increasing reliance on electronic medical records. *Canadian Medical Association. Journal*, *183*(1), E54–E55. http://search.proquest.com/docview/840339489?accountid=14732%5Cnhttp://bd9jx6as9l.search.serialssolutions.com/?ctx_ver=Z39.88-2004&ctx_enc=info:ofi/enc:UTF-8&rfr_id=info:sid/ProQ%3Ahealthcompleteshell&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=unk

Webster, P. C. (2013). EMRs for specialists: physicians take the helm. In *CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne* (Vol. 185, Issue 18). https://doi.org/10.1503/cmaj.109-4613

WHO. (2010). International Classification of Diseases (ICD-10). *Family Practice Management*.

WHO (World Health Organization). (2008). Framework and Standards for Country Health Information Systems. *World Health*, *2nd Editio*(January), 72. https://doi.org/10.4018/978-1-60566-988-5

Wolf, C., Joye, D., Smith, T., Fu, Y., & Willis, G. B. (2016). Questionnaire Pretesting. In

The SAGE Handbook of Survey Methodology. https://doi.org/10.4135/9781473957893.n24

World Health Organization. (2011). *eHealth at WHO*. Global Observatory for EHealth. https://www.who.int/goe/en/

Wyatt, J. C., & Sullivan, F. (2005). What is health information? *Bmj*, *331*(7516), 566. https://doi.org/10.1136/bmj.331.7516.566

Wyatt, J. C., & Wyatt, S. M. (2003). When and how to evaluate health information systems? *International Journal of Medical Informatics*, *69*(2–3), 251–259. https://doi.org/10.1016/S1386-5056(02)00108-9

Yeung, N. K., Jadad, A. R., & Shachak, A. (2013). What do electronic health record vendors reveal about their products: An analysis of vendor websites. *Journal of Medical Internet Research, 15*(2). https://doi.org/10.2196/jmir.2312

Yu, P. (2010). A multi-method approach to evaluate health information systems. *Studies in Health Technology and Informatics*, *160*(PART 1), 1231–1235. https://doi.org/10.3233/978-1-60750-588-4-1231

Yusof, M. M., Kuljis, J., Papazafeiropoulou, A., & Stergioulas, L. K. (2008a). An evaluation framework for Health Information Systems: human, organization and technology-fit factors (HOT-fit). *International Journal of Medical Informatics*, *77*(6), 386–398. https://doi.org/10.1016/j.ijmedinf.2007.08.011

Yusof, M. M., Kuljis, J., Papazafeiropoulou, A., & Stergioulas, L. K. (2008b). An evaluation framework for Health Information Systems: human, organization and technology-fit factors (HOT-fit). *International Journal of Medical Informatics*, *77*(6), 386–398. https://doi.org/10.1016/j.ijmedinf.2007.08.011

Yusof, M. M., Papazafeiropoulou, A., Paul, R. J., & Stergioulas, L. K. (2008). Investigating evaluation frameworks for health information systems. *International Journal of Medical Informatics*, *77*(6), 377–385. https://doi.org/10.1016/j.ijmedinf.2007.08.004

Zimmerman, T. G. (2010). The case for electronic medical records-why the time to act is now. In *Osteopathic Family Physician* (Vol. 2, Issue 4, pp. 108–113). https://doi.org/10.1016/j.osfp.2010.03.003

Zitner, D., Protti, D., Lau, F., & Covvey, D. (2008). The Last 20 Years and Where We are Headed. *Healthcare Information Management and Communications Canada*, *22*(4). http://www.healthcareimc.com/main/

Appendices

Appendix A: Western University Research Ethics Board Approval Notice

Western Research

Western University Health Science Research Ethics Board
HSREB Delegated Initial Approval Notice

Principal Investigator: Dr. Candace Gibson
Department & Institution: Schulich School of Medicine and Dentistry\Pathology,Western University

Review Type: Delegated
HSREB File Number: 108486
Study Title: Regional Integration of Electronic Medical Records in South West Ontario: An Exploratory Inquiry.

HSREB Initial Approval Date: February 15, 2017
HSREB Expiry Date: February 15, 2018

Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Revised Western University Protocol	Received February 3, 2017	
Revised Letter of Information & Consent		2017/01/27
Instruments	Interview Questions	
Instruments	Questionnaire	
Recruitment Items	Initial Contact Letter (confirmed February 15, 2017)	
Recruitment Items	Reminder Letter (confirmed February 15, 2017)	

The Western University Health Science Research Ethics Board (HSREB) has reviewed and approved the above named study, as of the HSREB Initial Approval Date noted above.

HSREB approval for this study remains valid until the HSREB Expiry Date noted above, conditional to timely submission and acceptance of HSREB Continuing Ethics Review.

The Western University HSREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use Guideline for Good Clinical Practice Practices (ICH E6 R1), the Ontario Personal Health Information Protection Act (PHIPA, 2004), Part 4 of the Natural Health Product Regulations, Health Canada Medical Device Regulations and Part C, Division 5, of the Food and Drug Regulations of Health Canada.

Members of the HSREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Ethics Officer, on behalf of Dr. Joseph Gilbert, HSREB Chair
EO: Erika Basile ___ Nicole Kaniki ___ Grace Kelly ___ Katelyn Harris___ Nicola Morphet ___ Karen Gopaul ___

Western University, Research, Support Services Bldg., Ste. 5150
London, ON, Canada N6G 1G9 t. 519.661.2161 f. 519.661.3907 www.westernu.ca/research

Date: 5 February 2018

To: Candace Gibson

Project ID: 108486

Study Title: Regional Integration of Electronic Medical Records in South West Ontario: An Exploratory Inquiry.

Application Type: Continuing Ethics Review (CER) Form

Review Type: Delegated

Date Approval Issued: 05/Feb/2018

REB Approval Expiry Date: 15/Feb/2019

Dear Candace Gibson,

The Western University Research Ethics Board has reviewed the application. This study, including all currently approved documents, has been re-approved until the expiry date noted above.

REB members involved in the research project do not participate in the review, discussion or decision.

Western University REB operates in compliance with, and is constituted in accordance with, the requirements of the TriCouncil Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2); the International Conference on Harmonisation Good Clinical Practice Consolidated Guideline (ICH GCP); Part C, Division 5 of the Food and Drug Regulations; Part 4 of the Natural Health Products Regulations; Part 3 of the Medical Devices Regulations and the provisions of the Ontario Personal Health Information Protection Act (PHIPA 2004) and its applicable regulations. The REB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Please do not hesitate to contact us if you have any questions.

Sincerely,

Mrs. Erika Basile, Director, Office of Human Research Ethics, on behalf of Dr. Joseph Gilbert, HSREB Chair

Note: This correspondence includes an electronic signature (validation and approval via an online system that is compliant with all regulations).

Appendix B: Letter of Information and Consent

LETTER OF INFORMATION AND CONSENT

Study Title

Title: Regional Integration of Electronic Medical Records in South West Ontario: An Exploratory Inquiry

Principal Investigator

Dr. Candace Gibson
Associate Professor
Schulich School of Medicine & Dentistry, Western University
[redacted]

Co-Investigator

Sadiq Raji
PhD Candidate, Health Information Science
Faculties of Health Sciences and Information & Media Studies
[redacted]

Contact Information

Sadiq Raji
PhD Candidate, Health Information Science
Faculties of Health Sciences and Information & Media Studies
Western University
1151 Richmond St, London, ON N6A 3K7
[redacted]

Introduction

You are being invited to participate in this research study about the use and impact of Electronic Medical Records (EMR) and the regional integration of electronic health information in South West Ontario. This study is part of a PhD thesis, the purpose is to evaluate the use and impact of EMRs in primary health care in South West Ontario and define the stages through which regional integration of electronic health information can be routinely assessed.

This research involves surveying physicians working in family health teams, physician offices, community health centers and other primary health care delivery organizations in the region. Your recent experiences with EMR in your practice will be invaluable in helping to develop a maturity model for routine assessment of EMR use and impact in the region.

Background/Purpose

While integrated electronic health information system implementations have been increasing across Canada in recent years, the use and impact of EMRs and value to health care providers, their patients, and the healthcare system are not routinely assessed. In primary care, physician offices and family health teams continue to integrate EMR tools for the collection, transmission and use of health information. Insufficient evidence currently exists regarding the impact and benefits of integrated electronic health information systems to health care providers and patients in primary health care, and studies on the benefits of regional integration of primary health care information are scant. This study aims to find out more about the topic with the goal of developing a maturity model for routine assessment of the impact and net benefits of integrated electronic health information systems in primary health care in South West Ontario.

Study Design

The proposed study will use an exploratory design, applying qualitative and quantitative research approaches, using both grounded theory and principal components analysis to observe, discover, describe and analyze the process through which benefits and/or detriments of regional integration of electronic medical records in primary health care in South West Ontario are being realized and determined.

The target population is practicing physicians working in primary health care in South West Ontario (~ 3000). Research participants will be drawn from this population and will be identified from names and contact information available in publicly available directories such as the most recent version of the Canadian Medical Directory. Participants (about 300) will be chosen randomly with a geographical focus of southwest Ontario (and defined by the four regional Local Health Integration Networks or LHINs which make up the connecting SouthWest Ontario or cSWO cluster). This is expected to make the research more manageable and include individuals with a broad range of experiences with interests in and uses of the integrated electronic medical record.

What will happen during this study?

Participants will be asked to complete a self-administered questionnaire on the use and impact of Electronic Medical Records. Face to face interviews will also be conducted with a number of participants to obtain in-depth information regarding use, impact and perceptions of benefits and drawbacks of Electronic Medical Records.

The questionnaire was developed to collect data broadly from a number of primary health care practitioners across the four Local Health Integration Networks (LHINs) in South West Ontario. The main exploratory focus of the questionnaire will be on trying to ascertain the way in which the EMR is used and the extent and ease of use and exchange of information from different sources which will provide information on the general benefits and potential drawbacks of integrated electronic medical records. The emphasis is on the effects of regional integration of information systems in the region, rather than on a particular piece of technology.

Interviews will be held with physicians working within primary health care in South West Ontario. Twenty four participants will be selected to be interviewed using snowball sampling method. Snowballing is a method of expanding the sample by asking one informant or participant to recommend others for interviewing. Interviews will be conducted face to face on a one on one basis and will be recorded using a digital recorder. Participants who do not wish to be recorded will be accommodated through note taking by the investigator during the interview and by writing in field notes shortly after the interview.

How many people will take part in this study?

This Letter of Information and the questionnaire will be mailed to 300 randomly selected individuals from different areas within the region with a stamped, addressed return envelope, with the exception of those who will participate in the interview phase.

Procedures

This study will not involve clinical interventions with patients or physicians. The study procedure will include data collection using semi-structured interviews from key informants and a survey questionnaire.

Twenty four semi-structured interviews will be conducted to gather data for an in depth analysis of respondents' experience with electronic medical records and their views of the benefits and detriments of electronic medical records. Interviews will be recorded and transcribed verbatim. Subsequent interviews may be conducted as deemed necessary, in line with grounded theory approach (i.e. if new information is still being elicited from respondents).

Voluntary Participation

Your participation in this study is voluntary. You may decide not to be in this study, or to be in the study now and then change your mind later. You may leave the study at any time without

affecting your employment. We may provide you with new information that is learned from the study that might affect your decision to stay in the study.
You may refuse to answer any question you do not want to answer, or not answer an interview question by saying "pass".

Withdrawal from Study

You may leave the research study at any time. If you decide to withdraw from the study, the information that was collected before you leave the study will still be used in order to help answer the research question. No new information will be collected without your permission.

Conflict of Interest

There are no conflicts of interest to declare related to this study

Risks

There are no risks involved in participating in this study

Benefits

Your participation will contribute to better understanding of the use and impact of EMRs in the region and to the assessment of benefits and drawbacks of EMRs in the region.

The study will also contribute to a better understanding of the problems and challenges of evaluating the results of regional integration of electronic health information. It will assist those who are working in the field of primary health care to understand more fully the best use of electronic records and benefits and/or drawbacks that may accrue when access to more expanded information on their patients is available through an integrated electronic medical record. This may assist in accelerating adoption and more meaningful use of the electronic record.

Confidentiality

Your individual responses to the questions are confidential and will be known only to the researchers. Data will be reported and presented in aggregate form only in the thesis. Please note that although any comments you provide will not be attributed to you directly, a list of comments from all the surveys may be included in the thesis. To help maintain confidentiality, you have been assigned an ID number so that your name does not appear on the questionnaire. This ID number appears on the bottom right corner of the questionnaire and will be used for follow-up purposes only.

Your individual recording of responses to interview questions will be accessible only to the principal investigator and co-investigator of this study. To help maintain confidentiality of the recordings, each recording will be assigned an identification number. There will be no interviewee identifying information on the recordings. Recordings of the interviews, written notes and reports, as well as the analysis, will be kept in a locked file cabinet and/or in password protected files at the researchers' offices at Western University.

When the research activities are completed, all files will not be retained by the investigators. Paper records will be shredded, and data on the recording device will be erased. Recordings will not be archived for future use and future access to the research material will not be granted even if consent has been obtained from research participants.
Study data will be kept according to Western University Policy. Western's Health Sciences Research Ethics Board will have access to study data for quality assurance purposes.

Rights as a Participant

Your decision to complete and return the study questionnaire will be interpreted as an indication of your consent to participate. If you decide to withdraw from the study, you have the right to request withdrawal of information collected about you. A written consent will be obtained from interviewees by the researchers for the interview phase of the research to proceed.

Questions about the Study

If you have any questions about this project or why you received a questionnaire, please feel free to contact Dr. Candace Gibson at [redacted] candaceg@uwo.ca or Sadiq Raji at Western University sraji@uwo.ca [redacted]. If you have any questions about your rights as a research participant in the study, or the conduct of this study you may contact the Office of Human Research Ethics (519)-661-3036, email: ethics@uwo.ca

Western UNIVERSITY · CANADA

Participant Interview Consent Form

As a participant in this study, Regional Integration of Electronic Medical Records in South West Ontario: An Exploratory Inquiry, I understand the general nature, purpose, and procedures of the study as explained to me by the investigator. The study has been explained to me and any questions I had have been answered.

I also understand that data resulting from my participation in this study will not identify me or my institution, and that I may withdraw at any time. I agree to take part in the study.

I hereby give permission for:

a) Audio recording of my conversation with the investigator: _______ _______
Yes No
(Please initial)

b) Education and research use by the investigator of audio recordings and transcripts made from the conversations.

______________________ ______________________ ______________________
Print Study Participant's Name Signature Date (DD-MMM-YYYY)

______________________ ______________________ ______________________
Print Name of Investigator Signature Date (DD-MMM-YYYY)

Appendix C: Study Questionnaire

Questionnaire on EMR Use and Impact in South West Ontario

Dear Participant,

You are being invited to participate in this research study about the use and impact of Electronic Medical Records (EMR) and the regional integration of electronic health information systems in South West Ontario. This study is part of a PhD thesis; the purpose is to evaluate the use and impact of EMRs in primary health care in South West Ontario and define the stages through which regional integration of electronic health information can be routinely assessed in the region. The study will examine EMRs and related health information resources in South West Ontario such as the regional clinical viewer ClinicalConnect, Hospital Report Manager, Patient Portals, Laboratory Information Systems, and Drug Information Systems.

The questionnaire should take 20-30 minutes to complete. In completing the questionnaire, we request that you kindly provide frank and honest answers to serve as an invaluable expert resource for this study. Your responses will be kept strictly confidential and the information you provide will be used only in connection with the research. The questions are organized into three parts. Part one asks for your demographic information, part two asks about your EMR access and experience, part three asks about EMR use and impact. Your participation will contribute to better understanding of the use and impact of EMRs in the region.

Your decision to complete and return the study questionnaire will be interpreted as an indication of your consent to participate. Your participation in this study is voluntary. If you decide to withdraw from the study, you have the right to request withdrawal of information collected about you.

Should you require additional information, please do not hesitate to contact us at the addresses below. Thank you very much for your time and cooperation. Your help and assistance in this inquiry is greatly appreciated.

[redacted]

Dr. Candace Gibson (Principal Investigator)
Associate Professor
Schulich School of Medicine & Dentistry
Western University

Sadiq Raji (Co-Investigator)
PhD Candidate, Health Information Science
Faculty of Health Sciences and
Faculty of Information and Media Studies

[redacted]
candaceg@uwo.ca [redacted]
[redacted] sraji@uwo.ca

Part 1 Demographic Information

Please select the boxes as applicable.

1. Gender

☐ Male ☐ Female ☐ Other

2. Please select the age group that best describes you, in years?

☐ <35 ☐ 35-44 ☐ 45-54 ☐ 55-64 ☐ 65+

3. How long have you been in primary health care practice, in years?

☐ 0 - 5 ☐ 6 - 10 ☐ 11 - 15 ☐ 16 - 20 ☐ 21- 25 ☐ 26 - 30 ☐ > 30

4. Which of the following professions best describes you?

☐ Family Physician ☐ General Practitioner

☐ Resident ☐ Nurse

☐ Other (please specify) ____

5. Which of the following best describes your place of work?

☐ Physician Office – Solo practice ☐ Physician Office – Group practice

☐ Family Health Team ☐ Walk-in Clinic

☐ Community Health Centre ☐ Community Care Access Centre ☐ Hospital

☐ Other (please specify) ____

6. Which Local Health Integration Network (LHIN) does your practice belong to?

☐ LHIN 1 Erie St. Clair ☐ LHIN 2 South West

☐ LHIN 3 Waterloo Wellington ☐ LHIN 4 Hamilton Niagara Haldimand Brant

☐ Don't Know

Part II Electronic Medical Record Access and Experience

7. Do you use an Electronic Medical Record in your practice?

☐ Yes ☐ No

8. If you answered no, what is the major reason for not using an Electronic Medical Record?

____

If you answered 'No' please send the questionnaire in the enclosed, stamped envelope. If you answered 'Yes', please continue with the questionnaire and send the completed form in the enclosed envelope.

9. Which Electronic Medical Record do you use? Please select.

☐ ABELMed EHR - EMR/PM v12
☐ Accuro EMR CMS4 - ASP
☐ Accuro EMR CMS4 - Local
☐ Clinic Information System (CIS) - Complete EMR v8.0 - Clinic Edition
☐ Clinic Information System (CIS) - Complete EMR v8.0 - Enterprise Edition
☐ EMR Advantage 3.2
☐ GlobeMed v2.0
☐ Indivicare 4
☐ Med Access EMR v4.3
☐ Nightingale On-Demand v9.0 - ASP
☐ Nightingale On-Demand v9.0 - Local
☐ OSCAR v15*
☐ PS Suite v5.2 - ASP
☐ PS Suite v5.2 - Local
☐ YES EMR v2.0
☐ YMS EMR v8.7 + 4.5
☐ Other ____________________

10. How long have you had an EMR in your practice, in years?

☐ < 1 ☐ 1 - 3 ☐ 4 - 6 ☐ 7 - 9 ☐ > 10

11. Did you receive any funding or financial incentives to adopt the EMR?

☐ Yes ☐ No

12. Do you receive any funding to maintain your EMR?

☐ Yes ☐ No

13. Does your practice rely on a vendor to maintain EMR functions?

☐ Yes ☐ No

14. If you rely on a vendor, is access to personal health data assured to be secure, private and confidential by the vendor?

☐ Yes ☐ No

15. Did you receive any training on how to use the EMR in your practice?

☐ Yes ☐ No

16. Do you access your EMR on the internet, via the cloud?

☐ Yes ☐ No

17. Do you routinely access your EMR remotely from home or elsewhere?

☐ Yes ☐ No

18. Has your system ever been breached or accessed inappropriately by an unauthorized user?

☐ Yes ☐ No

19. Would you recommend your EMR to other primary care physicians in South West Ontario?

☐ Yes ☐ No

20. How would you rate the EMR currently used in your practice?

☐ Poor ☐ Fair ☐ Good ☐ Very Good ☐ Excellent

Part III Electronic Medical Record Use and Impact

Please indicate your level of agreement with the following statements. Feel free to add any further information that you think clarifies your answer.

21. I use my EMR for billing and scheduling.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

22. My EMR provides tools to record the current problem and keep a continuous patient profile (CPP).

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

23. My EMR provides features to collect, store and update patient family history information.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

24. My EMR provides tools to collect, store and update patient socio-economic information.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

25. I prescribe medications using the EMR in my practice.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

26. I keep a medication list of patient current and past drugs using the EMR in my practice.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

27. I record and retrieve patient immunization information using my EMR.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

28. I record and retrieve patient allergy information using my EMR.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

29. I can generate a clinical summary for each visit to give to a patient using my EMR.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

30. My EMR provides alerts (e.g. for drug interactions, allergies, severe reaction, abnormal test result).

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

31. My EMR provides reminders (e.g. for preventative screening, immunizations, follow-up appointments).

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

32. My EMR provides care guidelines, care paths and other decision support tools.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

33. I can easily generate a list of all patients taking a particular medication in my practice.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

34. I can easily generate a list of all laboratory results for an individual patient in my practice.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

35. I can easily generate a list of patients by diagnosis using my EMR.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

36. I can use the EMR to determine how many of my patients receive recommended preventive care.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

37. I can use my EMR to generate a list of patients with multiple chronic conditions along with their prescriptions and lab test results in a given time period.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

38. My EMR incorporates tools such as tables or graphs to track and support patient care over time including duration of condition, changes in severity and related time series or trend information.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

39. I receive lab test results through Ontario Lab Information System (OLIS) in my EMR.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

40. My EMR provides tools to link a unique lab report to a patient encounter.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

41. I routinely use Hospital Report Manager to retrieve details of patients' recent hospital visits.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

42. Information retrieved from the Hospital Report Manager is always timely, accurate and complete.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

43. My EMR provides tools to support coordination of patient care needs related to ambulatory, nursing home, emergency and hospital care.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

44. I use my EMR to reconcile differences between patient reported information and information existing in EHR, OLIS, HRM and other sources.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

45. I have the regional web-based portal "ClinicalConnect".

☐Yes ☐No

46. I routinely use ClinicalConnect to retrieve data.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

47. Please indicate what kind of data you usually retrieve through ClinicalConnect.

____

48. Data accessed through ClinicalConnect is always timely, accurate and complete.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

49. I am able to import data from other EMR or EHR systems.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

50. My practice has an individual or group responsible for ensuring quality, security and privacy of health information in the practice.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

51. My EMR allows electronic formation of clinical teams with defined role and responsibilities.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

52. My practice routinely receives information on how our clinical performance compares to other practices.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

53. My practice can review our clinical performance against regional, provincial and national targets.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

54. My EMR allows me to securely track and coordinate ancillary services such as community services, transportation, interpretation, social services, case management and financial assistance tailored to individual patients.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

55. My EMR provides tools to link and exchange information with mental health resources and programs.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

56. My EMR provides tools to link and exchange information with public and population health resources and programs.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

57. My EMR provides tools to link and exchange information with community resources, programs and caregivers that may support primary health care patient needs.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

58. I can enter or sync patient data from other devices such as mobile devices to my EMR.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

59. My patients can enter, retrieve or update information directly through patient portals, open notes or shared information spaces during a visit.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

60. My EMR supports patients' requests for referrals online.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

61. My practice supports enhanced asynchronous patient care via email, texting, video-conferencing, and other bidirectional communication mechanisms.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

62. My EMR supports patients to electronically request or schedule appointments.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

63. My EMR incorporates educational materials, decision aids or patient value assessment tools to support patient-clinician shared decision making.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

64. When I update patient information in the EMR, I usually allow patients to review, correct and update their health information.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

65. My patients can view their lab test results securely online.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

66. My EMR supports patient online requests for refills of prescription.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

67. I feel comfortable answering patients' questions while using the EMR.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

68. I can record and upload multimedia (audio, video, images) from a patient visit into my EMR in simple and intuitive formats.

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

69. My EMR supports data collection that meet regional, provincial and national health information standards (e.g., coding standards, terminology standards, data quality standards).

☐Strongly Disagree ☐Disagree ☐ Neither Agree nor Disagree ☐Agree ☐Strongly Agree

70. What is the most significant impact of EMR use on your practice?

____

____

____

____

Thank you very much for participating in the survey. Please return the completed questionnaire in the enclosed, stamped envelope.

Appendix D : Questionnaire Item Groundwork and Sources

Items on the questionnaire were developed from outcomes of groundwork from lay of the land consultations held in 2016, observership and shadowing held in 2016, personal communications with principal investigator held in 2016 and published sources, as shown in the following table. Items in parenthesis indicate the year in which the groundwork took place or year of publication of published sources.

Questionnaire Items		Groundwork/Sources
Part 1 Demographic Information	1	Canadian Medical Directory, (2016); Observership/shadowing (2016); Lay of the land consultations (2016); Statistics Canada (2010); Encyclopedia of research design (2010); Duberstein et al. (2007)
	2	
	3	
	4	
	5	
	6	
Part 2 EMR Access and Experience	7	Research questions (2016)
	8	Research questions, Consultations (2016)
	9	OntarioMD(2016)
	10	Research questions (2016); Consultations (2016)
	11	OntarioMD(2016); Consultations (2016); Observership (2016)
	12	OntarioMD(2016)
	13	OntarioMD(2016); Consultations (2016); Observership (2016); Yeung, Jadad & Shachak (2013)
	14	OntarioMD(2016); Consultations (2016); Observership (2016); Yeung, Jadad & Shachak (2013)
	15	Pantaleoni,Stevens,Mailes,Goad & Longhurst (2015)
	16	Gibson (2016)
	17	Consultations (2016); Observership (2016) ; Joos,Chen, Jirjis & Johnson (2006); Zheng, Yi,Shirkey,Ashton,Way & Bass (2015)
	18	Yaraghi (2016); Medical Data Privacy Handbook (Gkoulalas-Divanis & Loukides (2015))
	19	Consultations (2016); Observership (2016); Commonwealth Fund (2015)
	20	Consultations (2016); Observership (2016); Commonwealth Fund (2015); CMA (2014); Jaspers, Peute, Lauteslager & Bakker(2008)
Part 3 Electronic Medical Record Use and Impact	21	Consultations (2016); Observership (2016)
	22	Consultations (2016); Observership (2016)
	23	Consultations (2016); Observership (2016)
	24	Gibson (2016); Ammenwerth, Graber, Herrmann, Burkle & Konig (2003)
	25	Monte, Anderson, Hoppe, Weinshilboum, Vasiliou & Heard (2015); Gibson (2016); Consultations (2016); Observership (2016)

Questionnaire Items		Groundwork/Sources
	26	Gibson (2016); Consultations (2016); Observership (2016); Canadian Newswire (2013); Barnett & Jennings (2009)
	27	Gibson (2016); Consultations (2016); Observership (2016); Canadian Newswire (2013);Barnett & Jennings (2009)
	28	Gibson (2016); Consultations (2016); Observership (2016); Barnett & Jennings (2009)
	29	Gibson (2016); Consultations (2016); Observership (2016); Krist et al. (2014); Barnett & Jennings (2009)
	30	Gibson (2016); Consultations (2016); Observership (2016); Krist et al. (2014); Barnett & Jennings (2009)
	31	Gibson (2016); Consultations (2016); Observership (2016); Krist et al. (2014); Barnett & Jennings (2009)
	32	Gibson (2016); Consultations (2016); Observership (2016); Krist et al. (2014); Barnett & Jennings (2009)
	33	Gibson (2016); Consultations (2016)
	34	Gibson (2016); Consultations (2016); Observership (2016); Krist et al. (2014); Barnett & Jennings (2009)
	35	Gibson (2016); Consultations (2016); Observership (2016); Krist et al. (2014); Barnett & Jennings (2009)
	36	Gibson (2016); Consultations (2016)
	37	Gibson (2016); Consultations (2016); Observership (2016); Krist et al. (2014); Barnett & Jennings (2009)
	38	Gibson (2016); Consultations (2016)
	39	OntarioMD (2015); Ontario Ministry of Health and Long Term Care (2004)
	40	Gibson (2016); Consultations (2016); Observership (2016); OntarioMD (2015); Ontario Ministry of Health and Long Term Care (2004)
	41	Observership (2016); Larsen (2015)
	42	Observership (2016); Larsen (2015)
	43	Archer& Cocosila (2014); Krist (2014); Bassi, Lau, Lesperance (2012); Alvarez (2004)
	44	Archer& Cocosila (2014); Krist (2014); Bassi, Lau, Lesperance (2012); Alvarez (2004)
	45	eHealth Ontario (2014, 2016); Alexander (2016); Gibson (2016); Consultations (2016); Observership (2016); Eapen & Chapman (2015)
	46	eHealth Ontario (2014, 2016); Alexander (2016);Gibson (2016); Consultations (2016); Observership (2016); Eapen & Chapman (2015)
	47	eHealth Ontario (2014, 2016); Alexander (2016);Gibson (2016); Consultations (2016); Observership (2016); Eapen & Chapman (2015)
	48	eHealth Ontario (2014, 2016); Alexander (2016); Gibson (2016); Consultations (2016); Observership (2016); Eapen & Chapman (2015)
	49	Kuo, Kushniruk, Borycki, Hsu, & Lai (2011)
	50	Observership (2016)
	51	CIHI (2016); Consultations (2016); Observership (2016); The Commonwealth Fund (2012, 2015); Protti & Johansen (2010)
	52	CIHI (2016); The Commonwealth Fund (2012, 2015)
	53	CIHI (2016); The Commonwealth Fund (2012, 2015)
	54	Alexander (2016); Gibson (2016); Consultations (2016); Observership (2016); Krist et al. (2014)
	55	Alexander (2016);Gibson (2016); Consultations (2016); Observership (2016)
	56	Adenuga, Kekwaletswe & Coleman (2015); Gaynor, M., Yu, F., Andrus, Bradner & Rawn (2014); Caralli, Knight & Montgomery (2012)
	57	Adenuga, Kekwaletswe & Coleman (2015); Gaynor, M., Yu, F., Andrus, Bradner & Rawn (2014); Caralli, Knight & Montgomery (2012)
	58	Krist et al. (2014); Katz, Nissan & Moyer(2004)
	59	Miller et al. (2016); Patrick (2014) Steele et. al (2014); Middleton et al. (2013); Majeed et al. (2008); Van Der Meijden et al. (2003)
	60	Miller et al. (2016); Patrick (2014) Steele et. al (2014); Middleton et al. (2013); Majeed et al. (2008); Van Der Meijden et al. (2003)
	61	Miller et al. (2016); Patrick (2014) Steele et. al (2014); Middleton et al. (2013); Majeed et al. (2008); Van Der Meijden et al. (2003)
	62	Miller et al. (2016); Patrick (2014) Steele et. al (2014); Middleton et al. (2013); Majeed et al. (2008); Van Der Meijden et al. (2003)

Questionnaire Items		Groundwork/Sources
	63	Miller et al. (2016); Patrick (2014) Steele et. al (2014); Middleton et al. (2013); Majeed et al. (2008); Van Der Meijden et al. (2003)
	64	Miller et al. (2016); Patrick (2014) Steele et. al (2014); Middleton et al. (2013); Majeed et al. (2008); Van Der Meijden et al. (2003)
	65	Miller et al. (2016); Patrick (2014) Steele et. al (2014); Middleton et al. (2013); Majeed et al. (2008); Van Der Meijden et al. (2003)
	66	Miller et al. (2016); Patrick (2014) Steele et. al (2014); Middleton et al. (2013); Majeed et al. (2008); Van Der Meijden et al. (2003)
	67	Miller et al. (2016); Patrick (2014) Steele et. al (2014); Middleton et al. (2013); Majeed et al. (2008); Van Der Meijden et al. (2003)
	68	Adenuga, Kekwaletswe & Coleman (2015); Gaynor, M., Yu, F., Andrus, Bradner & Rawn (2014); Caralli, Knight & Montgomery (2012)
	69	CIHI (2016); Consultations (2016); Observership (2016); The Commonwealth Fund (2012, 2015); Protti & Johansen (2010)
	70	Werner & Arora(2016); Lau et al. (2012); Chaudhry et al (2006); Wager, Lee,White, Ward & Ornstein(2000)

Appendix E: Detailed Results of Difference Tests.

1. Years in primary health care practice (Years_PHC) and stages of the maturity model

Stage 1 findings

Stage 1		
Years_PHC	N	Rank Sum
1 (0 to 5)	7	143.5
2 (6 to 10)	6	114
3 (11 to 15)	7	185.5
6 (26 to 30)	5	105.5
7 (> 30)	17	354.5
Chi-squared = 2.135 with 4 d.f.		
Probability = 0.7110		

Table 26. Stage 1 findings (years in primary health care practice and stages of the maturity model)

Kruskal-Wallis test results revealed no statistically significant difference in Stage 1 of the maturity model and years of primary health care practice at 0.05 significance level, x^2 (4)=2.135, p=0.7110, with rank sum score of 143.5 for 0 to 5 years of practice, 114 for 6 to 10 years of practice, 185.5 for 11 to 15 years of practice, 105.5 for 26 to 30 years of practice and 354.5 for more than 30 years of practice.

Stage 2 findings

Stage 2		
Years_PHC	N	Rank Sum
1 (0 to 5)	7	127.5
2 (6 to 10)	5	114.5
3 (11 to 15)	7	168.5
6 (26 to 30)	6	121
7 (> 30)	16	329.5
Chi-squared = 1.628 with 4 d.f.		
probability = 0.8037		

Table 27. Stage 2 findings (years in primary health care practice and stages of the maturity model)

Kruskal-Wallis test results revealed no statistically significant difference in Stage 1 of the maturity model and years of primary health care practice at 0.05 significance level, x^2

(4)=1.628, p=0.8037, with rank sum score of 127.5 for 0 to 5 years of practice, 114.5 for 6 to 10 years of practice, 168.5 for 11 to 15 years of practice, 121 for 26 to 30 years of practice and 329.5 for more than 30 years of practice.

Stage 3 findings

Stage 3		
Years_PHC	N	Rank Sum
1 (0 to 5)	7	157
2 (6 to 10)	5	131
3 (11 to 15)	7	144
6 (26 to 30)	6	112
7 (> 30)	15	276
Chi-squared = 2.189 with 4 d.f.		
Probability = 0.7010		

Table 28. Stage 3 findings (years in primary health care practice and stages of the maturity model)

Kruskal Wallis test results revealed no statistically significant difference in Stage 3 of the maturity model and years of primary health care practice at 0.05 significance level, x^2 (4)=2.189, p=0.7010, with rank sum score of 157 for 0 to 5 years of practice, 131 for 6 to 10 years of practice, 144 for 11 to 15 years of practice,112 for 26 to 30 years of practice and 276 for more than 30 years of practice. Due to small sample and presence of ties, results should be interpreted with caution.

Stage 4 findings

Stage 4		
Years_PHC	N	Rank Sum
1 (0 to 5)	7	155.5
2 (6 to 10)	6	147
3 (11 to 15)	7	149.5
6 (26 to 30)	4	68
7 (> 30)	14	221
Chi-squared = 4.391 with 4 d.f.		
Probability = 0.3557		

Table 29. Stage 4 findings (years in primary health care practice and stages of the maturity model)

Kruskal Wallis test results revealed no statistically significant difference in Stage 4 of the maturity model and years of primary health care practice at 0.05 significance level, x^2 (4)=4.391, p=0.3557, with rank sum score of 155.5 for 0 to 5 years of practice, 147 for 6 to 10 years of practice, 149.5 for 11 to 15 years of practice, 68 for 26 to 30 years of practice and 221 for more than 30 years of practice. Due to small sample and presence of ties, results should be interpreted with caution.

Stage 5 findings

Stage 5		
Years_PHC	N	Rank Sum
1 (0 to 5)	7	103
2 (6 to 10)	6	132
3 (11 to 15)	7	168
6 (26 to 30)	6	153.5

7 (> 30)	17	389.5
Chi-squared = 3.490 with 4 d.f.		
Probability = 0.4795		

Table 30. Stage 5 findings (years in primary health care practice and stages of the maturity model)

Kruskal Wallis test results revealed no statistically significant difference in Stage 5 of the maturity model and years of primary health care practice at 0.05 significance level, x^2 (4)= 3.490, p= 0.4795, with rank sum score of 103 for 0 to 5 years of practice, 132 for 6 to 10 years of practice, 168 for 11 to 15 years of practice, 153.5 for 26 to 30 years of practice and 389.5 for more than 30 years of practice. Due to small sample and presence of ties, results should be interpreted with caution.

Stage 6 findings

Stage 6		
Years_PHC	N	Rank Sum
1 (0 to 5)	7	149.5
2 (6 to 10)	6	157.5
3 (11 to 15)	5	132.5
6 (26 to 30)	6	145.5
7 (> 30)	16	235
Chi-squared = 8.636 with 4 d.f.		
Probability = 0.0709		

Table 31. Stage 6 findings (years in primary health care practice and stages of the maturity model)

Kruskal Wallis test results revealed a higher degree of difference in Stage 6 and years of primary health care practice at 0.05 significance level, x^2 (4)=8.636, p=0.07, with rank sum score of 149.5 for 0 to 5 years of practice, 157.5 for 6 to 10 years of practice, 132.5 for 11 to 15 years of practice, 145.5 for 26 to 30 years of practice and 232 for more than 30 years of practice. Due to small sample and presence of ties, results should be interpreted with caution.

Summary of findings on difference in number of years spent in primary health care practice and six stages of the maturity model.

Kruskal Wallis test results revealed no significant difference in Stages 1 to 5 outcomes and number of years physicians have spent in primary health care practice "Years_PHC" at 0.05 significance level. However, it appears Stage 6 has a higher degree of difference in number of years physicians have spent in primary health care practice "Years_PHC" compared to the rest of the Stage variables.

2. Difference in location of practice and stages of the maturity model

Stage 1 findings

Stage 1		
LHIN	Obs	Rank Sum
2 (LHIN2)	21	442.5

3 (LHIN3)	9	230.5
4 (LHIN4)	14	317
Chi-squared = 1.137 with 2 d.f.		
Probability = 0.5665		

Table 32. Stage 1 findings (location of practice and stages of the maturity model)

Kruskal-Wallis test results revealed no statistically significant difference in Stage 1 of the maturity model and location of practice operationalized by LHIN at 0.05 significance level, x^2 (2) =1.137, p=0.5665, with rank sum score of 442.5 for LHIN2, 230.5 for LHIN3, 317 for LHIN4.

Stage 2 findings:

Stage 2		
LHIN	Obs	Rank Sum
2 (LHIN2)	21	459
3 (LHIN3)	9	209
4 (LHIN4)	13	278
Chi-squared = 0.197 with 2 d.f.		
Probability = 0.9060		

Table 33. Stage 2 findings (location of practice and stages of the maturity model)

Kruskal-Wallis test results revealed no statistically significant difference in location of practice operationalized by LHIN and Stage2 of the maturity model at 0.05 significance level, x^2 (2) =0.197 , p=0.9060, with rank sum score of 459 for LHIN2, 209 for LHIN3, and 278 for LHIN4.

Stage 3 findings

Stage 3		
LHIN	N	Rank Sum
2 (LHIN2)	20	364.5
3 (LHIN3)	9	219.5
4 (LHIN4)	13	319
Chi-squared = 2.990 with 2 d.f.		
Probability = 0.2243		

Table 34. Stage 3 findings (location of practice and stages of the maturity model)

Kruskal-Wallis test results revealed no statistically significant difference in Stage 3 of the maturity model and location of practice operationalized by LHIN at 0.05 significance level, x^2 (2)=2.990 , p=0.2243, with rank sum score of 364.5 for LHIN2, 219.5 for LHIN3, and 319 for LHIN4.

Stage 4 findings:

Stage 4		
LHIN	N	Rank Sum
2 (LHIN2)	16	219.5
3 (LHIN3)	10	258.5
4 (LHIN4)	12	263
Chi-squared = 9.653 with 2 d.f.		
Probability = 0.008		

Table 35. Stage 4 findings (location of practice and stages of the maturity model)

Test results revealed a strong Kruskal-Wallis significant difference in location of practice operationalized by LHIN and Stage 4 of the maturity model at 0.05 significance level, x^2

(2) = 9.653, p=0.008, with rank sum score of 219.5 for LHIN2, 258.5 for LHIN3, and 263 for LHIN4.

Stage 5 findings:

Stage 5		
LHIN	N	Rank Sum
2 (LHIN2)	20	390.5
3 (LHIN3)	11	243.5
4 (LHIN4)	13	356
Chi-squared = 3.362 with 2 d.f.		
Probability = 0.1862		

Table 36. Stage 5 findings (location of practice and stages of the maturity model)

Kruskal-Wallis test results revealed no statistically significant difference in Stage 5 of the maturity model and location of practice operationalized by LHIN at 0.05 significance level, x^2 (2)=3.362 , p=0.186, with rank sum score of 390.5 for LHIN2, 243.5 for LHIN3, and 356 for LHIN4.

Stage 6 findings

Stage 6		
LHIN	N	Rank Sum
2 (LHIN2)	19	327.5
3 (LHIN3)	10	281.5
4 (LHIN4)	13	294
Chi-squared = 6.298 with 2 d.f.		
Probability = 0.0429		

Table 37. Stage 6 findings (location of practice and stages of the maturity model)

Test results revealed a strong Kruskal-Wallis statistical difference in location of practice operationalized by LHIN and Stage 6 of the maturity model at 0.05 significance level, x^2 (2)=6.298 , p=0.0429, with rank sum score of 327.5 for LHIN2, 281.5 for LHIN3, and 294 for LHIN4.

Summary of findings for association test between location of practice and stages of the maturity model

Stages 4 and 6 show a strong significant Kruskal-Wallis test results with location of practice (LHIN) at 0.05 significance level. However, it was not the case for rest of the stage variables.

3. How a physician rated EMR in use in their practice and stages of the maturity model

How physicians rated EMR in use in their primary health care practices was coded as EMRAE20 (EMRAE stands for Electronic Medical Record Access and Experience, and 20 represents the 20^{th} item on the questionnaire).

Stage 1 findings

Stage 1		
EMRAE20	N	Rank Sum
2 (Fair)	5	37.5
3 (Good)	12	288

4 (V. Good)	17	413.5
5 (Excellent)	10	251
Chi-squared = 11.877 with 3 d.f.		
Probability = 0.0078		

Table 38. Stage 1 findings (physician EMR rating and stages of the maturity model)

Results revealed a strong Kruskal-Wallis difference in how physicians rated EMR used in their practice and Stage 1 of the maturity model at 0.05 significance level, x^2 (2)=11.877 , p=0.0078, with rank sum score of 37.5 for Fair rating, 288 for Good rating, 413.5 for Very good rating, and 251 for Excellent rating.

Stage 2 findings

Stage 2		
EMRAE20	N	Rank Sum
2 (Fair)	5	49
3 (Good)	13	308
4 (V. Good)	17	373
5 (Excellent)	8	216
Chi-squared = 11.620 with 3 d.f.		
Probability = 0.0088		

Table 39. Stage 2 findings (physician EMR rating and stages of the maturity model)

Results revealed a strong Kruskal-Wallis difference in how physicians rated EMR used in their practice and Stage 2 of the maturity model at 0.05 significance level, x^2 (2)=11.620 , p=0.0008, with rank sum score of 49 for Fair rating, 308 for Good rating, 373 for Very good rating, and 216 for Excellent rating.

Stage 3 findings

Stage 3		
EMRAE20	N	Rank Sum
2 (Fair)	5	43.5
3 (Good)	13	232.5
4 (V. Good)	17	416
5 (Excellent)	8	254
Chi-squared = 13.806 with 3 d.f.		
Probability = 0.0032		

Table 40. Stage 3 findings (physician EMR rating and stages of the maturity model)

Test results revealed a strong Kruskal-Wallis difference in how physicians rated EMR used in their practice and Stage 3 of the maturity model at 0.05 significance level, x^2 (2)=13.806 , p=0.00032, with rank sum score of 43.5 for Fair rating, 232.5 for Good rating, 416 for Very good rating, and 254 for Excellent rating.

Stage 4 findings

Stage 4		
EMRAE20	N	Rank Sum
2 (Fair)	4	46.5
3 (Good)	10	232
4 (V. Good)	17	321.5
5 (Excellent)	8	180
Chi-squared = 4.174 with 3 d.f.		
Probability = 0.2433		

Table 41. Stage 4 findings (physician EMR rating and stages of the maturity model)

Kruskal-Wallis test results revealed no statistically significant difference between Stage 4 of the maturity model and how physicians rated the EMR currently in use in their practice at 0.05 significance level, x^2 (2)=4.174 , p=0.2433, with rank sum score of 46.5 for Fair rating, 232 for Good rating, 321.5 for Very good rating, and 180 for Excellent rating.

Stage 5 findings

Stage 5		
EMRAE20	N	Rank Sum
2 (Fair)	5	108.5
3 (Good)	13	346.5
4 (V. Good)	16	265
5 (Excellent)	10	270
chi-squared = 6.841 with 3 d.f.		
probability = 0.0771		

Table 42. Stage 5 findings (physician EMR rating and stages of the maturity model)

Kruskal-Wallis test results revealed no statistically difference in Stage 5 of the maturity model and how physicians rated the EMR currently in use in their practice at 0.05

significance level, x^2 (2)=6.841 , p=0.0771, with rank sum score of 108.5 for Fair rating, 346.5 for Good rating, 265 for Very good rating, and 270 for Excellent rating.

Stage 6 findings

Stage 6		
EMRAE20	N	Rank Sum
2 (1 to 3 yrs)	5	104.5
3 (4 to 6 yrs)	12	272.5
4 (7 to 9 yrs)	18	388.5
5 (>10 yrs)	7	137.5
chi-squared = 0.339 with 3 d.f.		
probability = 0.9526		

Table 43. Stage 6 findings (physician EMR rating and stages of the maturity model)

Kruskal-Wallis test results revealed no statistically significant difference in Stage 6 of the maturity model and how physicians rated EMR currently in use in their practice at 0.05 significance level, x^2 (2)=0.339 , p=0.9526, with rank sum score of 104.5 for Fair rating, 272.5 for Good rating, 388.5 for Very good rating, and 137.5 for Excellent rating.

Summary of findings for test of differences between how a physician rated EMR in use in their practice and stages of the maturity model

Difference test between how physicians rate the EMR currently in use in their practice "EMRAE20" and Stages 1 to 6 through Kruskal Wallis test reveals that the first three stages variables (Stage 1,2 &3) show a strong significant Kruskal Wallis test results with "EMRAE20" at 0.05 significance level. However, this was not the case for the remaining three stages (Stage 4,5, &6).

4. Length of EMR use and stages of the maturity model

Note that "EMRAE10" was code for how long physician has had an EMR in use, or length of EMR use by the physician, where EMRAE stands for Electronic Medical Record Access and Experience, and 10 stands for the 10^{th} item on the questionnaire.

Stage 1 findings

Stage 1		
EMRAE10	N	Rank Sum
2 (1 to 3 yrs)	6	124.5
3 (4 to 6 yrs)	8	189.5
4 (7 to 9 yrs)	11	216.5
5 (>10 yrs)	22	597.5
chi-squared = 3.752 with 3 d.f.		
probability = 0.2895		

Table 44. Stage 1 findings (length of EMR use and stages of the maturity model)

Kruskal-Wallis test results revealed no statistically significant association between Stage 1 of the maturity model and how long a physician has used an EMR, or length of EMR use by the physician at 0.05 significance level, x^2 (2)=3.752 , p=0.2895, with rank sum score of 124.5 for 1 to 3 years of EMR use, 189.5 for 4 to 6 years of EMR use, 216.5 for 7 to 9 years of EMR use, and 597.5 for longer than 10 years of EMR use.

Stage 2 findings

Stage 2		
EMRAE10	Obs	Rank Sum
2 (1 to 3 yrs)	6	88
3 (4 to 6 yrs)	8	194
4 (7 to 9 yrs)	11	261
5 (>10 yrs)	21	538
chi-squared = 5.177 with 3 d.f.		
probability = 0.1593		

Table 45. Stage 2 findings (length of EMR use and stages of the maturity model)

Kruskal-Wallis test results revealed no statistically significant difference in Stage 2 of the maturity model and how long a physician has used an EMR, or length of EMR use by the physician at 0.05 significance level, x^2 (2)=5.177 , p=0.1593, with rank sum score of 88 for 1 to 3 years of EMR use, 194 for 4 to 6 years of EMR use, 261 for 7 to 9 years of EMR use, and 538 for longer than 10 years of EMR use.

Stage 3 findings

Stage 3		
EMRAE10	Obs	Rank Sum
2 (1 to 3 yrs)	6	106.5
3 (4 to 6 yrs)	8	186
4 (7 to 9 yrs)	11	207

5 (>10 yrs)	20	535.5
chi-squared = 4.084 with 3 d.f.		
probability = 0.2525		

Table 46. Stage 3 findings (length of EMR use and stages of the maturity model)

No statistically significant difference was detected in Stage 3 of the maturity model and how long a physician has used an EMR, or length of EMR use by the physician at 0.05 significance level, x^2 (2)=3.729 , p=0.2923, with rank sum score of 106.5 for 1 to 3 years of EMR use, 186 for 4 to 6 years of EMR use, 207 for 7 to 9 years of EMR use, and 535.5 for longer than 10 years of EMR use.

Stage 4 findings

Stage 4		
EMRAE10	Obs	Rank Sum
2 (1 to 3 yrs)	6	133.5
3 (4 to 6 yrs)	6	168.5
4 (7 to 9 yrs)	11	193.5
5 (>10 yrs)	18	365.5
chi-squared = 3.715 with 3 d.f.		
probability = 0.2940		

Table 47. Stage 4 findings (length of EMR use and stages of the maturity model)

Kruskal-Wallis test results revealed no statistically significant difference in Stage 4 of the maturity model and how long a physician has used an EMR, or length of EMR use by the physician at 0.05 significance level, x^2 (2)=3.715 , p=0.2940, with rank sum score of 133.5 for 1 to 3 years of EMR use, 168.5 for 4 to 6 years of EMR use, 193.5 for 7 to 9 years of EMR use, and 365.5 for longer than 10 years of EMR use.

Stage 5 findings

Stage 5		
EMRAE10	Obs	Rank Sum
2 (1 to 3 yrs)	6	100
3 (4 to 6 yrs)	8	224.5
4 (7 to 9 yrs)	12	234.5
5 (>10 yrs)	21	569
chi-squared = 5.377 with 3 d.f.		
probability = 0.1462		

Table 48. Stage 5 findings (length of EMR use and stages of the maturity model)

Kruskal-Wallis test results revealed no statistically significant difference in Stage 5 of the maturity model and how long a physician has used an EMR, or length of EMR use by the physician at 0.05 significance level, x^2 (2)=5.377 , p=0.1462, with rank sum score of 100 for 1 to 3 years of EMR use, 224.5 for 4 to 6 years of EMR use, 234.5 for 7 to 9 years of EMR use, and 569 for longer than 10 years of EMR use.

Stage 6 findings

Stage 6		
EMRAE10	Obs	Rank Sum
2 (1 to 3 yrs)	6	170
3 (4 to 6 yrs)	7	197.5
4 (7 to 9 yrs)	12	270
5 (>10 yrs)	20	397.5
chi-squared = 3.801 with 3 d.f.		
probability = 0.2838		

Table 49. Stage 6 findings (length of EMR use and stages of the maturity model)

Kruskal-Wallis test results revealed no statistically significant difference in Stage 6 of the maturity model and how long a physician has used an EMR, or length of EMR use by the physician at 0.05 significance level, x^2 (2)=3.801 , p=0.2838, with rank sum score of 88 for 1 to 3 years of EMR use, 194 for 4 to 6 years of EMR use, 261 for 7 to 9 years of EMR use, and 538 for longer than 10 years of EMR use.

Summary of findings for difference test between length of EMR use and stages of the maturity model

Test of differences between "EMRAE10" and Stages(1-6) through Kruskal Wallis test reveals none of the stage variables showed a significant test result with "EMRAE10" or how long physicians have had an EMR in their practice at 0.05 significance level.

5. Sex of physician and stages of the maturity model

Difference test between "Sex" and Stages (1-6) through Wilcoxon-Mann-Whitney test.

Stage 1 findings

Stage 1		
Sex	Obs	Rank Sum
1 (Male)	24	545
2(Female)	23	583
chi-squared = 0.628 with 1 d.f.		
probability = 0.4281		

Table 50. Stage 1 findings (sex of physician and stages of the maturity model)

Wilcoxon-Mann-Whitney test results revealed no statistically significant difference in sex of physician and Stage 1 of the maturity model at 0.05 significance level, x^2 (2) =0.628 , p=0.4281, with rank sum score of 545 for male and 583 for female.

Stage 2 findings

Stage 2		
Sex	Obs	Rank Sum
1 (Male)	25	566
2(Female)	21	515
chi-squared = 0.369 with 1 d.f.		
probability = 0.5433		

Table 51. Stage 2 findings (sex of physician and stages of the maturity model)

Wilcoxon-Mann-Whitney test results revealed no statistically significant difference in sex of physician and Stage 2 of the maturity model at 0.05 significance level, x^2 (2) =0.369 , p=0.5433, with rank sum score of 566 for male and 515 for female.

Stage 3 findings

Stage 3		
Sex	Obs	Rank Sum
1 (Male)	24	564
2(Female)	21	471
chi-squared = 0.082 with 1 d.f.		
probability = 0.7751		

Table 52. Stage 3 findings (sex of physician and stages of the maturity model)

Wilcoxon-Mann-Whitney test results showed no statistically significant difference in between sex of physician and Stage 3 of the maturity model at 0.05 significance level, x^2 (2) =0.082 , p=0.7751, with rank sum score of 564 for male and 471 for female.

Stage 4 findings

Stage 4		
Sex	Obs	Rank Sum
1 (Male)	21	448.5
2(Female)	20	412.5
chi-squared = 0.046 with 1 d.f.		
probability = 0.8308		

Table 53. Stage 4 findings (sex of physician and stages of the maturity model)

Wilcoxon-Mann-Whitney test results revealed no statistically significant difference in sex of physician and Stage 4 of the maturity model at 0.05 significance level, x^2 (2) =0.046 , p=0.8308, with rank sum score of 448.5 for male and 412.5 for female.

Stage 5 findings

Stage 5		
Sex	Obs	Rank Sum
1 (Male)	25	573.5
2(Female)	22	554.5
chi-squared = 0.0361 with 1 d.f.		
probability = 0.5481		

Table 54. Stage 5 findings (sex of physician and stages of the maturity model)

Wilcoxon-Mann-Whitney test results revealed no statistically significant difference in sex of physician and Stage 5 of the maturity model at 0.05 significance level, x^2 (2) =0.0361 , p=0.5481, with rank sum score of 573.5 for male and 554.5 for female.

Stage 6 findings

Stage 6		
Sex	Obs	Rank Sum
1 (Male)	25	544.5
2(Female)	20	490.5
chi-squared = 0.569 with 1 d.f.		
probability = 0.4507		

Table 55. Stage 6 findings (sex of physician and stages of the maturity model)

Wilcoxon-Mann-Whitney test results revealed no statistically significant differences in sex of physician and Stage 6 of the maturity model at 0.05 significance level, x^2 (2) =0.569 , p=0.4507, with rank sum score of 544 for male and 490 for female.

Summary of findings:

Test of association between "Sex" and Stages(1-6) through Wilcoxon-Mann-Whitney test revealed that none of the stage variables showed a significant association test result with sex of physician at 0.05 significance level.

6. Ordinal regression analysis result

Ordinal regression analysis was conducted to further analyze the ordinal Likert scale outcomes, for Stage 1 to Stage 6 of the maturity model. The analysis was an adjusted one that simultaneously took into account the effect of covariates of sex (Sex), age group (Age-Group) ,years spent in primary health care practice (Years_PHC), years of having an EMR in practice (EMRAE10) and how the physician rates EMR currently used in practice (EMRA20). The software employed for this analysis was SAS 9.4 and Proc Logistic was chosen to carry out the analysis. There were several considerations regarding the current dataset that should be taken into account while interpreting ordinal logistic regression results for this study, which might be attributable to perfect or quasi perfect separation, that necessitates cautionary interpretation of results:

1. Sample size was very small.
2. All covariates were of categorical nature.
3. Some covariates might have hidden collinearity.

Results presented should be considered as exploratory rather than confirmatory.

Additionally, a backward selection methodology was considered in order to detect the most significant list of independent covariates. This means that the analysis started with the full model of all variables and then variables were dropped that were not significant or needed one at a time. This was done to supplement a forward selection methodology where the analysis would start with the null model and predictors would be added as the analysis progressed.

Ordinal Logistic regression analysis results:

1. *Assessing years of practice (Years_PHC) and years of having an EMR in practice (EMRAE10)*

Regression Model:

Logit(EMRAE10) = $\beta_0 + \beta_2 * X_{\text{Years\_PHC}}$

Response profile for EMRAE10	**Levels**	**Total Frequency**
Ordered level	5	20
	4	12
	3	7
	2	6

Likelihood Ratio for Testing Null Hypothesis: Beta=0	Chi-square 114.3188 (P-value < 0.001)	

Table 56. Regression analysis result (years of primary health care practice and years of having an EMR)

Finding:

Complete separation of data points detected: These two variables are highly significant predictive factors of each other.

2. *Separately assessing association among location of practice (LHIN), years of practice (Years_PHC) and years of having an EMR in practice (EMRAE10)*

   Finding:

   Not a significant association at 0.05 significance level was detected.

3. *Separately assessing each stage of the maturity model association with covariates.*

<u>Stage 1</u>

Regression Model:

Logit (Stage1) = $\beta_0 + \beta_1 * X_{sex} + \beta_2 * X_{years\_PHC} + \beta_3 * X_{\text{EMRAE20}} + \beta_4 * X_{\text{EMRAE10}} + \beta_5 * X_{LHIN}$

Response Profile for Stage1	**Levels**	**Total Frequency**
Ordered level	5	24
	4	12
Likelihood Ratio for Testing Null Hypothesis: Beta=0	Chi-square 10.0720 P-value 0.018	
Summary of Forward Selection	Chi-square 9.1929 (P-value 0.0268)	

Table 57. Stage 1 findings (stage of the maturity model with covariates)

Finding:

Among all covariates entered into ordinal logistic regression, only adjusted effect of EMRAE20 (How the physician rates EMR currently in use in their practice") was recognized as significant.

Stage 2

Regression Model:

Logit (Stage2) = $\beta_0 + \beta_1 * X_{sex} + \beta_2 * X_{years\_PHC} + \beta_3 * X_{\text{EMRAE20}} + \beta_4 * X_{\text{EMRAE10}} + \beta_5 * X_{LHIN}$

Response profile for Stage2	**Levels**	**Total Frequency**
Ordered level	5	27
	4	8
Likelihood Ratio for Testing Null Hypothesis : Beta=0	Chi-square 10.098(P-value 0.017)	
Summary of Forward Selection	Chi-square 9.5017 (P-value 0.0233)	

Table 58. Stage 2 findings (stage of the maturity model with covariates)

Finding:

Among all covariates entered into ordinal logistic regression, only adjusted effect of “EMRAE20”(or “How the physician rates EMR currently in use in their practice”) was recognized as significant.

Stage 3

Regression Model:

Logit (Stage3) = β_0 +β_1*X_{sex}+β_2*X_{years_PHC}+β_3*X_{EMRAE20} + β_4*X_{EMRAE10} +β_5*X_{LHIN}

Response profile for Stage3	**levels**	**Total Frequency**
Ordered level	5	13
	4	11
	3	7
	2	4
Likelihood Ratio for Testing of Null Hypothesis : Beta=0	Chi-square	

Response profile for Stage3	**levels**	**Total Frequency**
	15.886 P-value 0.0012	
Summary of Forward Selection	Chi-square 12.918 P-value 0.0048	

Table 59. Stage 3 findings (stage of the maturity model with covariates)

Finding:

Among all covariates entered into ordinal logistic regression, only adjusted effect of “EMRAE20” (“How the physician rates EMR currently in use in their practice”) was recognized as significant. EMRAE20 level 5 is considered as reference

<u>Stage 4</u>

Regression Model:

Logit (Stage4) = β_0 +β_1*X_{sex}+β_2*X_{years_PHC}+β_3*X_{EMRAE20} + β_4*X_{EMRAE10} +β_5*X_{LHIN}

Response profile for Stage4	**Levels**	**Total Frequency**
Ordered level	4	4
	3	16
	2	13
Likelihood Ratio for Testing of Null Hypothesis : Beta=0	Chi-square 9.1968P-value 0.0101	
Summary of Forward Selection	Chi-square 8.0751 P-value 0.0176	

Table 60. Stage 4 findings (stage of the maturity model with covariates)

Finding:

Among all covariates entered into ordinal logistic regression, only adjusted effect of "LHIN" or location of practice was recognized as significant.

Stage 5

- **Regression Model:**
- Logit (Stage5) = β_0 +β_1*X_{sex}+β_2*X_{years_PHC}+β_3*X_{EMRAE20} + β_4*X_{EMRAE10} +β_5*X_{LHIN}

Response profile for Stage5	levels	Total Frequency
Ordered level	4	5
	3	15
	2	13
	1	4

Table 61. Stage 5 findings (stage of the maturity model with covariates)

Finding:

None of covariates was recognized as significant at 0.05% level.

<u>Stage 6</u>

Regression Model:

Logit (Stage6) = β_0 +β_1*X_{sex}+β_2*X_{years_PHC}+β_3*X_{EMRAE20} + β_4*X_{EMRAE10} +β_5*X_{LHIN}

Response profile for Stage6	**levels**	**Total Frequency**
Ordered level	3	6
	2	15
	1	13

Table 62. Stage 6 findings (stage of the maturity model with covariates)

Finding:

None of the covariates was recognized as significant at 0.05% level.

Appendix F: Interview Schedule

Interview Schedule

Western UNIVERSITY · CANADA

Interview of Primary Health Care Physicians' on EMR Use and Impact in South West Ontario

Script prior to interview:

I would like to thank you once again for participating in the interview phase of my study 'Regional Integration of Electronic Medical Records in South West Ontario: An Exploratory Inquiry'. As I have mentioned to you before, my study seeks to understand and evaluate the use and impact of electronic medical records (EMR) in South West Ontario. The study will also seek to understand physicians' perspectives on the use and impact of EMR in the region. Primary health care physicians and organizations are beginning to realize the importance of routine assessment of the use and impact of electronic medical records and leveraging the advantages of regional integration of electronic health information. I feel it is pertinent to address this issue through academic research with the ultimate aim of developing a (maturity) model for routine assessment of regional integration of electronic medical records in South West Ontario.

Our interview today will last approximately one hour (or less) during which I will be asking you about your experiences with EMRs and related health information resources such as the regional clinical viewer ClinicalConnect, Hospital Report Manager, Patient Portals, Laboratory Information Systems, Drug Information Systems and other components of an integrated electronic health information system such as policies and procedures. The interview is intended to deeply explore your views of the benefits or lack thereof of the use of EMR.

[Review aspects of the consent form]

You completed a consent form indicating that I have your permission (or not) to audio record our conversation.

Are you still okay with me recording (or not) our conversation today? _______Yes ______No

If yes: Thank you! Please let me know if at any point you want me to turn off the recorder or keep something you said off the record.

If no: Thank you for letting men know. I will only take notes from our conversation.

Before we begin the interview, do you have any questions?

[Discuss outstanding questions or clarifications]

*Note that the interview schedule was modified as the research process progressed according to grounded theory procedure. Some of the modified questions are presented in red.

If any questions (or other clarifications) arise at any point in this study, please feel free to ask them at any time. I would be more than happy to answer your questions.

Interview Question	Follow-ups / Probes/Iterations
1. Could you tell me about your experience in primary health care (or as a family physician) the practices you've worked in family medicine)?	• How long have you worked in primary health care? • How long have your worked in your current position and location? • What kinds of patients do you usually see? How would you describe the patient population you usually see?
2. Tell me about your experience with electronic medical record in your practice	• Why and how did you decide on your current EMR • What do you use? • How long has the EMR been implemented in your practice? • How did you decide on your current EMR? • What did you take into account when you decided to adopt/buy/implement/use your current EMR? • Does the EMR meet your needs? • Have you implemented other EMRs in your practice? •

3. Could you describe your experience with EMR integration tools currently used in your practice?
 	
[By integration, I mean connectivity, linkages, interoperability of EMR and EMR related tools]
	• Do you use ClinicalConnect?
	  o What kind of information do you most frequently retrieve/access using ClinicalConnect? How easy is it to find and retrieve information in Clinical Connect? Is it timely? Accurate? Does ClinicalConnect produce the desired results? What challenges or barriers to use do you experience using ClinicalConnect?
	  o
	• Is your EMR connected to the Hospital Report Manager?
	  o What kind of information do you most frequently retrieve/access using HRM? How easy is it to find and retrieve information in HRM? What challenges or

Interview Question	Follow-ups / Probes/Iterations
	barriers to use do you experience using HRM? o Do you receive hospital discharge summaries within 24 hours of a patient visit? One week? • What about OLIS? o How easy is it to find and retrieve information in OLIS? Is it timely? Accurate? What challenges or barriers to use do you experience using OLIS? • Medication/Drug information system? o What kind of medication information system do you most frequently use? How easy is it to find and retrieve medication information? Is medication information always up to date? Accurate?? What challenges or barriers to use do you experience with medication information? Is medication information reconciled across providers? • Which of these tools do you prefer? • Do these tools produce the desired results? How easy is it to find and retrieve information? • How often have you had to repeat tests because the results weren't available in a timely manner? • e-referrals – can you easily book a consultation with another doctor/specialist through your EMR? • e-requisitions? • e-consults? • e-scheduling, e-ordering?
4. Could you describe your (as a primary care physician) typical daily experience with the EMR?	• How do you use it to help prepare for a patient visit? • How do you use the EMR during a patient visit? • How about after a patient visit?

Interview Question	Follow-ups / Probes/Iterations
Specifically, how does of integration of EMR impact on the the daily typical use and experience of primary health care physicians?	• What information do you most commonly search for or retrieve? • Is information always timely, accurate and complete? • How easily can you generate a list of patients on a given drug? • What do you usually do when you generate lists of patients? Do you link to other information sources? • How easily can you generate a list of all of your diabetic patients, hypertensive patients, pregnant patients (whatever is applicable?) • Do you use your EMR to view your patients as a population? • Can you determine how well they are maintaining their blood glucose, blood pressure, weight, etc. ? • Do you use flowsheets and templates integrated into the EMR to manage chronic conditions? • Are these lists integrated to other clinical data such as lab results, medication lists and progress notes? • Do you keep a registry or registries of patients with these disorders or others? • Does your system provide alerts and reminders for preventive screening tests/appointments? • How about reminders for needed vaccinations or immunizations (e.g., flu shots or pneumoccoccal vaccine in the elderly; mammography in eligible women, colon cancer screening? • Are reminders in place for at risk patients? • Do you ever experience alert fatigue? • Are you able to enrol your patients in provincial screening programs and have the results sent to your EMR?
5. What do you like about the EMR ?	• What do you like about the EMR? • Do you maintain paper records? Do you use a hybrid system (paper/electronic)?

Interview Question	Follow-ups / Probes/Iterations
	• Has your EMR ever failed? What do you do in the event of system failure? • Has the system ever been hacked? What do you in a hacking event? Do you have established protocols to follow in the event of a hacking event? • What do you dislike about the EMR?
6. Could you comment on the cost of the EMR?	• What impact has the EMR had on your overhead cost (any impact on storage cost, increase or reduction in chart pulls, photocopying, faxing health information, billings) • Did you receive any financial incentives to adopt the EMR? • Do you receive any incentives to maintain the EMR? • Do you derive any cost savings or return on investment?
7. Could you describe your experience with evaluating EMR integration tools currently used in your practice (in the region, province)? (Reminder: FOCUS ON IMPACT)	• Do you participate in use assessing how well ClinicalConnect works? Do you identify what areas of improvement you would like to see? • Same with Hospital Report Manager? • What about OLIS? • Medication/Drug information system? • Do these tools produce the desired results? How easy is it to find and retrieve information? Is it timely? Accurate?
8. How well are individuals trained to use the EMR?	• Do errors occur very often? • Do you have support to maintain the system? From whom? The vendors? • Do individuals communicate with colleagues about new ways to use the EMR?
9. What do you think about regional integration of EMR in South West Ontario? (CNEO,CSWO,CGTA)	• How involved are you and other primary care physicians in the process? • What do you think are the current benefits? • What are the potential benefits? • What do you think are the current hazards or challenges? • What are the potential challenges from your perspective?
10.What are the short-term impacts (challenges and benefits) of EMR regional integration?	• What are the positive impacts? • What are the negative impacts?

Interview Question	Follow-ups / Probes/Iterations
11. What are the anticipated long term impacts (challenges and benefits) of regional integration of EMR?	• **What are the positive impacts?** • **What are the negative impacts?**
12. Future Directions	• **From your experience, in what areas of your own practice would you like to see better information integration, exchange or interoperability of EMRs?** • **Do you ever survey your patients or solicit information from them about their health information and what health information resources they would like to see/have/use in the future?**

Appendix G: Examples of Analytic Memos

Here are examples of my analytic memos during interview phase of data collection/analysis.

Analytic memos: Categories of my memos
Observation notes (ON): As concrete and detailed as possible about what I saw, heard, felt, tested, etc. Methodological notes (MN): Notes to myself about how to collect 'data' – who to talk to, what to wear, when to phone, and so on. Theoretical notes (TN): Hunches, hypotheses, connections, alternative interpretations, critiques of what I am doing, thinking, seeing, etc. Conceptual notes (CN): Analytic notes comprising of my interpretation and combination of theoretical notes. These related theoretical notes derived from analysis similarities, differences or associations between and among theoretical notes. Personal notes (PN): These are my feelings about the research, who I was talking to, my doubts, anxieties and pleasures.
TN, PN (March 1) "Being comfortable with uncertainty"
TN: The interviewee discussed information in the practice, it is interesting to hear them state that information is an integral part of what they do yet a lot of that information gets lost in the process. To this respondent, some physicians and patients have a very low tolerance for uncertainty, yet some have a very high tolerance. The analogy to a baby was apt. Information is an entity in and of itself. Custodians of information can make assumptions or interpret information however they see fit, yet they don't have the right to impair that information, hence then need to be copacetic with uncertainty in terms of where information takes the user in the care delivery process. For example, some family docs will have a higher tolerance (for uncertainty) than an average specialist. Likewise, some patients love to have information while others are completely overwhelmed or may not have the capacity to understand it. Implementation process for EMR differs from a clinical implementation, which is different from the care plan implementation. The respondent emphasised the importance of seeing information as an extension of the patient. Though the responsibility to deliver best available care to patients might have triggered this reasoning, it is important to understand that the physician's experience with implementing health information systems in prior clinical settings might have influenced this perspective.
TN: "Doctors don't put information in with the thought of getting it out", such a powerful statement when respondent described the "implementation sales job". Selling EMR integration from local sites to regional integration to provincial integration seems to be the way EMR integration was envisioned, which, by and large, remains the grand vision despite challenges and several iterations. I thought the comparison to Kaiser Permanente was apt in terms of a regional operation. The size of Kaiser is

comparable to Ontario in terms of patient population. Should EMR integration be implemented at this level? What do we have to learn from the way Kaiser implemented or accomplished integration? The payment systems are different but are there lessons to learn from Kaiser?
PN: After several cancellations and rescheduling, this interview finally took place. Lengthy interview. I appreciate the time taken to do a quick shadowing with this physician and the amount of time spent answering my questions. H2next handy recorder ran out of memory after two hours, had to transfer files to laptop to continue the interview. Note to self: Reset recorder to mp3 to save space. Some interviews might last longer than anticipated, need to have a back up plan in such situations (e.g. detailed notes).
TN (Mar 6) "Comparing practice settings – Kaiser Permanente"
TN: This was a shorter interview than last one. However, it's interesting how the theme of practice context comparison is beginning to emerge. Kaiser came up again this time with emphasis on "mistake" that the province made in 2005. This respondent opines that the provincial government should have taken the lead of Kaiser and adopt one system for hospitals and one for primary care offices. The ideal integration in this scenario will involve some kind of integration tool or interphase between hospitals and primary care offices? I got an insight from this interview about proliferation of EMRs especially in south western Ontario. To this respondent, since tech companies such as McKesson left the region, south western Ontario experienced a sleuth of EMR entrants that "can't talk to each other". Respondent made other practice context comparisons (iCare at University of Iowa, mCare at Michigan). My understanding of the point being made here is that patients have access to their electronic health information within these practice contexts, and when patients leave these contexts their information follows them i.e. unlike what obtains in Ontario, access to the whole electronic file is granted to the patient.
ON, MN, TN (March 11) "Positioning" and "Transparency"
ON: Watching the participant work on the EMR confirms to me that physician's experience of EMR use is influenced by layout of the room. Previous participant acknowledges this without mentioning "positioning". Positioning not only refers to the location of the computer or information system in relation to the physician, it also refers to that of the physician in relation to the patient. This interviewee mentioned that previously, the physician in the clinic would have the chart up scribbling away with his back to the patient. Changing the positioning improves "transparency" with the patient because they (patients) can see what the physician is writing, and they can read along as the doctor types in the notes.
TN: Improving "clinical data work" was how this physician described the workarounds that he uses to enhance the use of EMR to accomplish hundreds of clinical tasks in a primary care physician's office. Writing own scripts or computer codes to make EMR easier to use suggests to me a more "mature EMR use". Not every physician is skilled enough to tap into all the features of their EMR, let alone write their own scripts to make clinical data work more efficient. "Insufficient training" in terms of what the vendors provide is the watch phrase. I did not realize that the peer leadership program

authorizes only three hours of training for peer leaders to provide. This physician thinks it's not enough. Perhaps something to follow up with OntarioMD or people at CSWO?
MN: "What is relevant" seems to not only apply to my methodological notes but now I can relate that to experience of moving from paper to electronic chart. The interviewee relates that they went through six months of chart of more than two thousand patients and determined "what is relevant" or what to include in the EMR. Not every patient data could be scanned or integrated with EMR, hence the need to "maintain paper records" for patients who have been going to the practice for a long time, whose information wasn't fully migrated. It's analogous to the research process where the researcher asks "what is relevant to ask", as data collection evolves, researcher goes back to the rationale for the research, refine questions or find new data sources.
MN, TN, PN (May 19) "Being truthful to the tablet"
TN: The statement that some patients are "being truthful to the tablet" in some situations than their family physician and therefore seemed more at ease to provide detailed and reliable information about their health was interesting. The interviewee tended to feel strongly that availability of the right technology for patients provides primary care practices with benefits that they could not have obtained from the EMR alone. This idea was described in the context of patients using tablets to answer questionnaires in the clinic, prior to seeing the doctor that help direct the physician to areas where the patient needs most attention, rather than merely asking patients routine questions.
TN: The main theme of integration with the EMR was highlighted though described in terms of use and impact such as making the practice more "efficient", "tracking patients" or just "checking on" them. The interviewee stated that by deploying tablet technology the practice has been "engaging" a bit more than in the past. I think this works best for patients with certain health issues (depression, anxiety) or as mentioned by the interviewee, for "baby checks", "patient screening", "compassion screening". Theoretically, this might be woven into "technology as enabler" theme as it represents an indication of using electronic health information tools to elicit health history directly from patient which may enhance timeliness, accuracy and completeness of the information received. It may also be a way of preparing both the patient and the physician for the actual encounter of the patient visit. Is there a drawback to this? What are the implications for integration with the EMR? How does physician or patient tech savviness play into this? Other than this practice, I have yet to encounter another practice in the region where it was mentioned during the interview that tablet has been deployed, nor have I encountered a physician who volunteers information about the use and impact of tablets in relation to EMR use, impact and integration.
MN: Subsequent interviewees could shed some light on "patient screening" to see how they use EMR to address patient problems, perhaps through information gathered from tablets?
PN: Despite taking the late train to Kitchener, I made it to the interview in ample time, enough to do a quick review of modified interview questions. I don't memorize all questions to ask beforehand, however, I find taking time to review helped me consider how questions would be asked, made me

feel better prepared and confident going into the research data collection arena. iPhone battery dies too soon, again! Get new iPhone, maybe not?

Appendix H: Sample Observership Request Form

London Health Sciences Centre

OBSERVER REQUEST FORM

Full Name of Observer: (print) ______________________________________ (Attach a current C.V or resume).

Category of Observer:

[ ] Physician [ ] Dentist [ ] Midwife [ ] Other *(please specify)* ________________

Purpose of Visit:
Explain what learning outcomes you expect to accomplish during your Observership

____

____

Start and End Dates of Observership:
Please indicate your anticipated start and end date (yyyy/mm/dd).

Start: ________________ End: ______________________

Sponsor Information:
Your Observership must be sponsored by a staff member or physician at the organization (a signature is required on page 2 of this document).

Sponsor's Name: ___________________________ Ext: ________________

Sponsor's Title: _________________________________

Department(s)/Program(s) of Observership:
List all programs and departments, including specific divisions/areas you wish to observe, if known:

____

____

Observer Location(s):
Please check all hospitals that apply to your request for Observership.

London Health Sciences Centre:
[ ] University Hospital [ ] Victoria Hospital [ ] South Street Hospital

Please continue to Read the Agreement & Acknowledgement of Role & Accountabilities.

1. The Observer ***will not***, under any circumstances, be involved in any form of direct patient care. Patient care involves, but is not limited to:
   - taking a medical history,
   - conducting physical examinations,
   - diagnosing or treating patient's condition,
   - ordering, preparing or administering drugs,

- documenting on patients' health records, either in electronic or hard copy format,
- having independent access to heath records, either in electronic or hard copy format,
- performing or assisting in surgical procedures, or diagnostic patient interventions
- obtaining consent,
- interacting directly with patient/SDM.
- providing health care advice.

2. All Observers must comply with London Health Sciences Centre Observer Policy for Medical and Non-Medical Observers; and any other relevant development policies and procedures as discussed with the sponsor.

3. All Observers are required to maintain patient confidentiality regarding all cases observed. **(You must read and sign the LHSC Observer Privacy & Confidentiality Agreement included in this package – Appendix B).**

4. Your sponsor must obtain a patient's verbal consent for your presence prior to any patient contact. A patient's right of refusal is to be respected at all times.

5. You must complete the Self-Screening Health Evaluation and return it with your documentation package and you must acknowledge that you have completed and agree to comply with the information presented on the form. (**Appendix C**)

6. You must complete the Infection Prevention and Control Core Competency Training and return it with your documentation package and you must acknowledge that you have completed and agree to comply with the information on the form. (**Appendix D**)

7. You must attach a current version of your C.V (or resume). A short version is acceptable.

Observer:

- ☐ I have read and fully understand the information provided in this documentation package.
- ☐ I am aware of and agree to comply with the aforementioned roles and accountabilities.
- ☐ I have completed and confirm my compliance with the Self-Screening Health Evaluation Form.
- ☐ I have completed and confirm my compliance with the Infection Prevention and Control Competency Training.
- ☐ I have attached a current copy of my C.V (or resume)

Signature: ______________________________ Date: __________________

Sponsor:

I agree that it is safe and appropriate for the above individual to assume an Observer role and acknowledge the aforementioned roles and accountabilities.

Printed name ______________________________

Signature: ______________________________ Date: __________________

Department Chief/Program Director/Professional Practice Leader:

I support the above Observership and acknowledge the aforementioned roles and accountabilities.

Printed name ______________________________

Signature: ______________________________ Date: __________________

Curriculum Vitae

Name:	Sadiq Raji
Post-secondary Education and Degrees:	York University Toronto, Ontario, Canada 2002-2006 B.H.S. Specialized Honours (Health Informatics) Dalhousie University Halifax, Nova Scotia, Canada 2006-2008 M.H.I. (Health Informatics) Western University London, Ontario, Canada 2014/15-2020/21 Ph.D. (Health Information Science)
Honours and Awards:	Canadian Millennium Scholarship 2003-2004, 2004-2005, 2005-2006 Dalhousie University Entrance Scholarship 2006 Western Graduate Research Scholarship 2014-2018
Related Work Experience	Senior Analyst (Clinical Administrative Databases, Health Human Resources, Canadian Population Health Initiative) Canadian Institute for Health Information Toronto and Ottawa, Ontario, Canada, 2007-2013 Graduate Teaching Assistant (Health Policy, Health Ethics, Therapeutic Modalities), Western University, London, Ontario, Canada, 2014-2018

Lecturer (Consumer Health Information, Introduction to Health Informatics (Guest)), Western University, London, Ontario, Canada, 2018-2019

Instructor (Information Literacy and Written Communications for the Health Sciences), Ontario Tech University-UOIT, Oshawa, Ontario, Canada, 2018-2019

Professor (Digital Health, Object Oriented Systems, Database Theory, Introduction to HTML/CSS, IT Project Management, Technical Writing), Mohawk College of Applied Arts and Technology, Hamilton, Ontario, 2019-2020

Publications, Posters and Presentations:

Raji, S. (2020). Regional Integration: Physician Perspectives on Use and Impact of Electronic Medical Record in South West Ontario - Thesis

eHealth Conference (2018). Regional Integration: Physician Perspectives on EMR Use and Impact - Presentation

London Health Research Day (2018). EMR Integration: Physician Experiences on the use and impact of electronic health information in South West Ontario - Poster

Canadian Institute for Health Information (2011). Urban Physical Environments and Health Inequalities (Ottawa, Ont.: CIHI) – Flagship Report

Canadian Institute for Health Information (2010) Hospitalization Disparities by Socio-Economic Status for Males and Female (Ottawa, Ont.: CIHI) – Analysis in Brief