

# Understanding, evaluating and enhancing electronic medical record adoption in a primary care setting:

A programme to improve electronic medical record data quality and its effect on family  
practice provision of incentivized and enhanced care for chronic disease patients

By

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B.Sc., Simon Fraser University, 2004

B.Sc., University of Victoria, 2008

A Thesis submitted in partial fulfillment of the requirements for the degree of

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### **Supervisory Committee**

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# Abstract

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Full service family physicians in British Columbia (BC) are claiming financial incentives in return for providing enhanced care for patients with chronic diseases. These same physicians are also being actively encouraged to adopt electronic medical record systems (EMRs) with an expectation that their adoption will, among other things, aid in improved chronic disease management (CDM). Indeed, both incentives and clinical information systems have been demonstrated in the literature to be crucial components in effective CDM programs. However, within BC little evidence is available that demonstrates whether EMR adoption is in fact associated with improved provision of CDM services. Furthermore, it is not well understood how the CDM incentive program affects a family practice's adoption of CDM-related EMR functionality. Through a mixed methods study the relationship between EMR adoption and CDM incentives in a small family practice is explored. Additionally, an audit and feedback intervention is used to test the hypothesis that both incentive use and EMR adoption can simultaneously be improved. Results of the study suggest that the presence of an EMR may not guarantee improvements in delivery of incentivized CDM services; that the incentive program has limits in its ability to promote adoption of CDM-related EMR features; and, that a program of audit and feedback may promote improvements in aspects of EMR adoption and incentive utilization.

## Table of Contents

<b>Supervisory Committee</b>	<b>ii</b>
<b>Abstract</b>	<b>iii</b>
<b>List of Tables</b>	<b>vii</b>
<b>List of Figures</b>	<b>viii</b>
<b>Acknowledgements</b>	<b>ix</b>
<b>1 Study synopsis</b>	<b>1</b>
1.1 Introduction	1
1.2 Research Intent	1
1.3 Research Rationale	2
1.4 General Study Approach	2
<b>2 Definitions and the British Columbian Context</b>	<b>4</b>
2.1 Primary Health Care & Primary Care	4
2.2 Family Physicians	4
2.3 Chronic Disease	5
2.4 Chronic Disease Management and the Chronic Care Model	5
2.5 Full Service Family Practice Incentives	7
2.6 Clinical Information Systems for Chronic Disease Management	14
2.7 Summary: Supporting provision of CDM services by EMR-Equipped Family Physicians	19
<b>3 Understanding, Evaluating and Enhancing EMR Adoption In Incentivized General Practice Contexts</b>	<b>21</b>

3.1 Introduction	21
3.2 Understanding Factors That Impact EMR Adoption	21
3.3 Assessing Levels of EMR Adoption	23
3.4 Measuring Data Quality As A Means To Assess EMR Adoption	25
3.5 Assessing Adoption Via Analysis of EMR Utilization	28
3.6 Assessing Incentive Use Via Analysis of EMR Administrative Data	28
3.7 Enabling Improvements in EMR Adoption and Incentive Utilization	29
<b>4 Methodology</b>	<b>33</b>
4.1 Research Design	33
4.2 Ethical Approval	37
4.3 Recruitment	37
4.4 Setting	38
4.5 Participants	38
4.6 Timing	39
4.7 Data Collection	40
4.8 Data Analysis	43
4.9 Intervention	45
<b>5 Results</b>	<b>47</b>
5.1 Practice & Physician Overview	47
5.2 Pre-Intervention Findings	47
5.3 Intervention Description	69
5.4 Post-Intervention Activities	71

5.5 Post-Intervention Findings	72
<b>6 Discussion</b>	<b>83</b>
6.1 Incentive Utilization at the Practice	83
6.2 Understanding EMR Adoption Using multiple instruments	85
6.3 From the Macro to The Micro: The Relationship Between EMR Adoption and Incentive Use	90
6.4 Supporting Improvements in EMR Data Quality and Adoption	96
6.5 Study Limitations	102
6.6 Challenges to Scaling the Research Approach	102
6.7 Ideas for Further Research	103
<b>7 Conclusion</b>	<b>104</b>
<b>8 References</b>	<b>106</b>
<b>9 Appendices</b>	<b>122</b>
9.1 Appendix A: Ethical Approval Certificate	122
9.2 Appendix B: Clinical Adoption Framework Interview Questions	123
9.3 Appendix C: Post-Intervention Focus Group Discussion Questions	127
9.4 Appendix D: EMR Adoption Survey Scores	128
9.5 Appendix E: Physician Level Prevalence and Incentive Utilization Rates	130
9.6 Appendix G: Select Intervention Presentation Slides	132

## List of Tables

Table 1: The Chronic Care Model Elements	6
Table 2: GPSC Priorities and related incentives and other initiatives	9
Table 3: The EMR Adoption Framework Five stage model of EMR Adoption	24
Table 4: eHealth Observatory EMR Data Quality Dimensions	26
Table 5: eHealth Observatory 10 step method for designing and executing a context sensitive data quality evaluation	27
Table 6: Research Questions and associated components of the research design	37
Table 7: Sequence of research activities	39
Table 8: Measures used to inform quasi-experiment intervention construction and results comparison	44
Table 9: Practice/Physician Overview	47
Table 10: Incentive earnings in select periods, 2009-11	57
Table 11: Completeness of Condition List, Billing Diagnoses and combinations in detecting diseased patients	64
Table 12: Disease prevalence rates from different sources	66
Table 13: Complex Care/Chronic Disease Patient Report Access, 2011-12	68
Table 14: Incentive earnings in select periods, 2009-2012	72
Table 15: Complex Care/Chronic Disease patient report access summary	76
Table 16: Data quality findings	77
Table 17: Select items used to measure TAM3 Constructs	94
Table 18: Summary of post-intervention changes in EMR adoption and incentive utilization	97

## List of Figures

Figure 1: The Clinical Adoption Framework with its micro, meso and macro dimensions	23
Figure 2: The PPRN-TRIP model for quality improvement	32
Figure 3: The Model for Improvement employed by the IHI	32
Figure 4: Embedded Design - Embedded Experimental Model	34
Figure 5: EMR Adoption Survey Practice Level Scores	48
Figure 6: Annual Incentives billed by Practice by Type, 2007-11	52
Figure 7: Annual Incentive Revenues earned by Practice by Type, 2007-11	52
Figure 8: Diabetes, Heart Failure and COPD Disease prevalence at Practice	53
Figure 9: Incentive utilization versus select practice disease prevalence rates	53
Figure 10: Complex Care Incentive Utilization by Physician, 2007-11	55
Figure 11: Billed versus unclaimed Complex Care Incentive physician revenues	55
Figure 12: 3 year trend of average monthly ACCB and CC billings	57
Figure 13: Average number of Annual Care Chronic Bonus billings claimed per month, 2009-11	58
Figure 14: Average number of Complex Care billings claimed per month, 2009-11	58
Figure 15: Average monthly earnings from combined ACCB and CC incentives, 2009-11	59
Figure 16: Patients seen for incentivized services in intervention period, 2009-11	59
Figure 17: Average number of Annual Care Chronic Bonus billings claimed per month, 2009-12	73
Figure 18: Average number of Complex Care billings claimed per month, 2009-12	73
Figure 19: Average monthly earnings from combined ACCB and CC incentives, 2009-12	74
Figure 20: Number of patients provided incentivized services, 2009-12	74
Figure 21: The Technology Acceptance Model 3 (TAM3)	94

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# 1 STUDY SYNOPSIS

## 1.1 INTRODUCTION

Full service family physicians in British Columbia (BC) are claiming financial incentives in return for providing enhanced care for patients with chronic diseases. These same physicians are also being actively encouraged to adopt electronic medical record systems (EMRs) with an expectation that their adoption will, among other things, aid in improved chronic disease management (CDM). Indeed, both incentives and clinical information systems have been demonstrated in the literature to be crucial components in effective CDM programs. However, within BC little evidence is available that demonstrates whether EMR adoption is in fact associated with improved provision of CDM services. Furthermore, it is not well understood how the CDM incentive program affects a family practice's adoption of CDM-related EMR functionality.

## 1.2 RESEARCH INTENT

This research set out to explore two issues:

- 1) How the presence of chronic disease management (CDM) incentives affect electronic medical record (EMR) adoption in a British Columbia (BC) group family practice, and conversely how the extent of EMR adoption affects the delivery of incentivized CDM care. Relevant objective and subjective data were interpreted through the lens of the Clinical Adoption Framework (Lau, Price, & Keshavjee, 2011) so as to ascertain the extent of any relationship between incentive availability, EMR adoption and other components of the BC primary care context.
- 2) Whether a United Kingdom-inspired program of EMR data analysis, feedback and provision of EMR support positively affects subsequent EMR adoption, EMR data quality, and delivery of incentivized CDM care by a BC family practice. This entailed the design, feasibility testing and execution of data extraction and data quality assessment techniques within the context of EMRs typically used within the province.

### **1.3 RESEARCH RATIONALE**

Within Canada, little research is available that provides insight into effective strategies that can be used to encourage greater adoption of EMRs, particularly for the purpose of improving provision of CDM care services. Although successful feedback-based strategies used in countries other than Canada are documented in the literature, it is unclear how they might apply in the Canadian and BC primary care context. As a result, Canadian EMR-invested parties have little field-tested research from which to draw on when designing EMR related support services for primary care users.

Secondly, there is no Canadian research available that explores whether the presence of CDM incentives provoke more sophisticated EMR adoption in general practice, or how such measurement might be possible. Hence, it is difficult to determine if financial incentivization should or could be used in the future to encourage greater use of EMRs by Canadian primary care providers.

Thirdly, few Canadian studies use both quantitative and qualitative instruments to evaluate EMR adoption levels. It is unclear whether the use of quantitative measures of EMR data quality, EMR feature utilization and incentive utilization will provide complementary, additional or contrary insights into levels of EMR adoption at a given practice when compared to findings of qualitative instruments, such as the EMR Adoption Survey. Furthermore, EMR data quality assessment methods and mixed methods studies have rarely been described in the Canadian literature.

Development and introduction of these methods, and the validation and possible refinement of the EMR Adoption Survey, may assist Canadian EMR-interested parties in conducting and designing EMR adoption assessments.

Finally, the Clinical Adoption Framework has had limited application in explaining observed use of clinical technologies such as EMRs. This research presented an opportunity to explore the usefulness of the framework in understanding, explaining and encouraging further EMR adoption in the BC primary care context.

### **1.4 GENERAL STUDY APPROACH**

This study was guided by the complimentary philosophies of realism and pragmatism (Robson, 2011, pp. 29–44). Grounded in realism, this study was concerned with enriching understanding of how *mechanisms* (e.g., policies or technologies) operating in a given *socially constructed context* (e.g., a typical BC family practice) promote *actions* (e.g., use of particular EMR features) that, in turn and in that context, illicit certain *outcomes* (e.g., improved adoption of EMRs or greater provision of CDM services) (Robson, 2011, p. 30). Following the pragmatic philosophy, the study employed a mixed methods design to achieve these goals. That is, all quantitative and qualitative methods of data collection and analysis that made practical sense in the context of the study, the site, and the researcher’s own expertise were considered for inclusion in the study design. Ultimately, a mixed methods design known as the Embedded Experimental Model was selected (J. Creswell & Clark, 2010, p. 69). Described in-depth later, this three phase design featured a quasi-experiment that was preceded by a preliminary round of qualitative investigation. Results of the qualitative investigation were used to justify and inform the design of a same group pre-test/post-test quasi-experiment focused on fostering improvements in EMR adoption and incentive utilization. Finally, a second qualitative investigation was employed to better interpret the observations made during the quasi-experiment.

In the next chapter, relevant study background and definitions are provided. Chapter Three provides an overview of the contributing theories, frameworks and previous research used to inform the study design while Chapter Four expands on the selected study methods and methodology. In Chapter Five, the results from each phase of the study are provided with interpretation and discussion provided in Chapter Six. Finally, a study conclusion is provided in Chapter Seven.

## 2 DEFINITIONS AND THE BRITISH COLUMBIAN CONTEXT

### 2.1 PRIMARY HEALTH CARE & PRIMARY CARE

*Primary health care* refers to an approach to health as well as a spectrum of services beyond the traditional health care system. It includes all services that play a part in health, such as income, housing, education, and environment. (Health Canada, 2006)

*Primary care* is the element within primary health care that focuses on health care services, including health promotion, illness and injury prevention, and the diagnosis and treatment of illness and injury (Health Canada, 2006). It is “that level of a health service system that provides entry into the system for all new needs and problems, provides person-focused (not disease-oriented) care over time, provides care for all but very uncommon or unusual conditions, and coordinates or integrates care provided elsewhere by others” (Starfield, 1998). Primary care services are often described as those provided by family physicians (Muldoon, Hogg, & Levitt, 2006).

### 2.2 FAMILY PHYSICIANS

In Canada, family physicians (FPs) are Doctors of Medicine (MDs) who have completed further postgraduate training to prepare for practice in family medicine. Accredited by the College of Family Physicians of Canada, MDs earn the additional designation of CCFP once they have successfully completed family medicine residency and a certification exam (College of Physicians & Surgeons of British Columbia, 2010). To retain the privilege of using the CCFP designation, FPs must pursue ongoing continuing professional development in order to earn a minimum number of Maintenance of Proficiency (Mainpro) credits in a given annual or multi-year cycle (The College of Family Physicians of Canada, 2011).

FPs may practice in a variety of settings and roles, some of which require additional training and certification. For example, FPs may work as hospitalists in acute care facilities, emergency room physicians, salaried or alternate payment physicians in publicly-funded clinics, or private fee-for-service physicians in walk-in clinics and “full service” family practices (Verma, 2011).

A “full service” FP is one who provides a patient with primary care throughout his or her life span and events, coordinates care through varying acute and chronic health and medical conditions, and maintains a longitudinal comprehensive patient record (Ministry of Health, 2011a). This is in contrast to both episodic centred care such as that which is provided by FPs working only within walk-in clinics and emergency rooms, or disease based care where FPs practicing within “carve-out” clinics provide care oriented to a specific disease or disease subset, such as congestive heart failure (Macgregor, 2002).

In the context of a lifelong physician-patient relationship full service FPs can be expected to provide care services that pertain to health events that extend beyond single episodes or diseases, such as palliative care, ongoing preventative care and education, and central to this research, chronic disease management (Ministry of Health, 2011b).

### **2.3 CHRONIC DISEASE**

Chronic diseases are diseases of long duration and generally slow progression. Chronic diseases, such as heart disease, stroke, cancer, chronic respiratory diseases and diabetes, are the leading cause of mortality in the world, representing 63% of all deaths. (World Health Organization, 2011)

In British Columbia (BC), as in the rest of Canada, one in three persons has at least one chronic condition (Ministry of Health, 2007a). Moreover, the 34% of people with a chronic condition consume 80% of BC’s provincial health care spending on physician payments, acute care, and medications (Ministry of Health Services, 2010). The health and financial toll of chronic disease, which grows larger each year as the population ages, has spurred the creation and adoption of new strategies designed to improve care for sufferers of chronic illness.

### **2.4 CHRONIC DISEASE MANAGEMENT AND THE CHRONIC CARE MODEL**

The Chronic Care Model (CCM) was derived in Seattle, Washington by Edward Wagner and colleagues working at the MacColl Institute for Healthcare Innovation at the Group Health Cooperative of Puget Sound (Ministry of Health, 2011c; Wagner et al., 2001). The CCM distilled evidence from the chronic care literature into a model which could be used to guide chronic care

improvements in health organizations (Coleman, Austin, Brach, & Wagner, 2009; Wagner et al., 2001).

According to Wagner et al., high quality chronic illness management was characterized as that which is organized and coordinated by a primary care practice team to enable high quality patient interactions which “consistently provide the assessments, support for self-management, optimization of therapy and follow-up associated with good outcomes” (Wagner et al., 2001). To increase the likelihood of such high quality interactions, the CCM posited that six elements ought to be fostered within both the community and the healthcare organization where care is delivered. These are described in Table 1.

**Table 1: The Chronic Care Model Elements**

CCM Element	Description	Examples
Health System Organization	Program planning that includes measurable goals for better care of chronic illness	<ul style="list-style-type: none"> <li>• Visible support of improvements provided by senior leadership</li> <li>• Incentives for care providers</li> </ul>
Self-Management Support	Emphasis on the importance of the central role that patients has in managing their own care	<ul style="list-style-type: none"> <li>• Educational resources, skills training and psychosocial support provided to patients</li> </ul>
Decision Support	Integration of evidence based guidelines into clinical practice	<ul style="list-style-type: none"> <li>• Wide dissemination of practice guidelines</li> <li>• Education and specialist support provide to healthcare team</li> </ul>
Delivery System Design	Focus on teamwork and expanded scope of practice for team members to support chronic care	<ul style="list-style-type: none"> <li>• Planned visits and sustained follow-up</li> <li>• Clearly define roles of healthcare team</li> </ul>
Clinical Information Systems	Developing information systems based on patient populations to provide relevant client data	<ul style="list-style-type: none"> <li>• Surveillance system that provides alerts, recall and follow-up information</li> <li>• Identification of relevant patient subgroups requiring proactive care</li> </ul>
Community Resources & Policies	Developing partnerships with community organizations that support and meet patients’ needs	<ul style="list-style-type: none"> <li>• Identify effective programs and encourage participation</li> <li>• Referral to relevant community based services</li> </ul>

In partnership with the Institute for Health Improvement (IHI) Breakthrough Series (BTS), the CCM was used by over one hundred health care organizations in attempts to improve the quality of care for chronic conditions, namely diabetes, heart failure, frailty in the elderly, depression and asthma. Early BTS results demonstrated the CCM was successful in facilitating improvements, and later analysis by Coleman et al. revealed that CCM-based interventions beyond the BTS fostered both process of care and outcome improvements in many cases (Coleman et al., 2009). Notable enablers of improvement across CCM elements included the *utilization of disease registries, computerized reminders and guideline-incorporated, registry-linked patient assessment and planning tools* (e.g. flow sheets and visit reports). In the context of small practices, *clinical information system support and consultation* was also reported as important. Examples of system support and consultation include regular construction and distribution of performance monitoring reports; pre-visit reviews of flowsheets by non-physician staff to highlight care concerns; technical support and training; and data input assistance for physicians (Bodenheimer, Wagner, & Grumbach, 2002). Also associated with success were the *presence of financial incentives* and the *removal of financial disincentives* to encourage interventions designed to improve chronic disease care. (Coleman et al., 2009; Wagner et al., 2001)

In 2002/3, the CCM was adopted by BC's Ministry of Health Services after extension by the Vancouver Island Health Authority (VIHA) to include health promotion activities (Ministry of Health Planning, 2003). Key to the implementation of the expanded CCM in British Columbia was the creation of the evidence based guidelines which could offer decision support and the introduction of clinical information systems to help track and manage chronic disease populations. Also key was the participation of family physicians, particularly the full service family physicians that would ultimately provide the bulk of chronic disease care. In 2007, the Primary Health Care Charter again emphasized the importance of system and practice redesign and information technology as key enablers for implementing the expanded CCM (Ministry of Health, 2007a).

## **2.5 FULL SERVICE FAMILY PRACTICE INCENTIVES**

At the time the CCM was adopted, full service family practice had been in a state of decline for nearly a decade in British Columbia and the rest of Canada. Family physicians, who were frustrated with compensation relative to specialists and with the lack of ongoing training and support to assist them in providing care to an increasing complex population were experiencing low morale, withdrawing provision of services such as maternity care, dropping hospital privileges and opting to work less or on shifts in walk-in clinics (Mazowita & Cavers, 2011). Wait times increased and many practices stopped accepting new patients. Moreover, Canadian graduating doctors were choosing family medicine residencies at just half the rate they had in the past (Sullivan, 2003).

Ontario, Alberta and Quebec responded to this pan-Canadian trend with structural reform whereby physicians were encouraged to leave solo or small group practices, relinquish fee-for-service payments in favor of alternate payment models (e.g salary or capitation), and join larger health teams or community health clinics (Mazowita & Cavers, 2011). British Columbia, in contrast, opted to introduce operational changes to revitalize and encourage comprehensive, fee-for-service practice – largely through the creation of training and incentive programs.

In 2002, the General Practice Services Committee (GPSC) was convened in a joint effort between the Ministry of Health, the British Columbia Medical Association (BCMA) and the Society of General Practitioners of BC (SGP) to collaboratively develop solutions to “support and sustain” full-service family practice in BC (General Practice Services Committee, 2010; Hollander, Kadlec, Hamdi, & Tessaro, 2009). In September of 2003, under the Chronic Care Practice Enhancement Incentive Pilot Project, the GPSC introduced two financial incentives for family physicians supplying guideline-based care to patients with diabetes and congestive heart failure, respectively (Ministry of Health, 2003). Over time the scope of the GPSC incentive program grew, with subsequent Physician Master Agreements including increased funding so that eight priority areas could be addressed. These include: 1) Chronic Disease Management (CDM), 2) Maternity care, 3) Care of the frail elderly, and patients requiring end-of-life care, 4) Patients with complex care needs, 5) Prevention, 6) Mental Health, 7) Recruitment and retention of full-service family practitioners, and 8) Multidisciplinary care between general practitioners and health care providers. Table 2

provides a list of initiatives and incentives that have been established by the GPSC in support of these eight priority areas. As of April 1, 2011 the GPSC had been allocated \$799 million dollars to address these priorities.

**Table 2: GPSC Priorities and related incentives and other initiatives**

GPSC Priority	Initiative	Incentive (Value)
Chronic Disease Management (CDM)	<ul style="list-style-type: none"> <li>• CDM Incentives for: Diabetes, Congestive Heart Failure, Hypertension, and Chronic Obstructive Pulmonary Disease</li> <li>• Mental Health Initiative</li> <li>• Complex Care Initiative for patients with two or more specified chronic conditions</li> </ul>	<ul style="list-style-type: none"> <li>• GP Annual Chronic Care Bonus – Diabetes Mellitus (\$125)</li> <li>• GP Mental Health Planning Fee (\$100)</li> <li>• Annual Complex Care Management Fee (\$315)</li> </ul>
Maternity Care	<ul style="list-style-type: none"> <li>• Maternity Network Initiative</li> <li>• GP Obstetrical Delivery Bonuses</li> <li>• Maternity Care for BC</li> </ul>	<ul style="list-style-type: none"> <li>• Maternity Network Incentive (\$2100 per quarter)</li> <li>• GP Obstetric delivery bonus associated with post natal care after an elective c-section (50% bonus on associated delivery fee)</li> <li>• Funding to undergo training in order to provide obstetrical care (up to \$47 729)</li> </ul>
Care of the frail elderly, and patients requiring end-of-life care	<ul style="list-style-type: none"> <li>• Palliative Care Initiative</li> <li>• Patient Conferencing Initiative</li> </ul>	<ul style="list-style-type: none"> <li>• Palliative Care Planning Fee (\$100)</li> <li>• Facility Patient Conference Fee (\$40 per 15 minutes)</li> </ul>
Patients with complex care needs	<ul style="list-style-type: none"> <li>• Complex Care Initiative for patients with two or more specified chronic conditions</li> </ul>	<ul style="list-style-type: none"> <li>• Annual Complex Care Management Fee (\$315)</li> <li>• GP Telephone/Email Management Fee (\$15)</li> </ul>
Prevention	<ul style="list-style-type: none"> <li>• Personal Health Risk Assessment Fee for patients with key risk factors</li> </ul>	<ul style="list-style-type: none"> <li>• Personal Health Risk Assessment (\$50)</li> </ul>
Mental Health	<ul style="list-style-type: none"> <li>• Mental Health Initiative</li> <li>• Patient Conferencing Initiative</li> </ul>	<ul style="list-style-type: none"> <li>• GP Mental Health Planning Fee (\$100)</li> </ul>

		<ul style="list-style-type: none"> <li>Community Patient Conference Fee (\$40 per 15 minutes)</li> </ul>
Recruitment and Retention of full-service FPs	<ul style="list-style-type: none"> <li>Divisions of Family Practice</li> <li>Family Physicians for BC</li> <li>Practice Support Program</li> </ul>	<ul style="list-style-type: none"> <li>\$12 million for infrastructure to support ~30 divisions throughout the province</li> <li>Family Physicians for BC program (up to \$100 000 for GP joining group practice in community of need)</li> <li>Paid GP/MOA learning sessions for office efficiency, CDM, end-of-life care, practice self-assessment, etc.</li> </ul>
Multidisciplinary Care	<ul style="list-style-type: none"> <li>Patient Conferencing Initiative</li> <li>Maternity Network Initiative</li> </ul>	<ul style="list-style-type: none"> <li>General Practice Urgent Telephone Conference with a Specialist Fee (\$40)</li> <li>Maternity Network Incentive (\$2100 per quarter)</li> </ul>

(General Practice Services Committee, 2010, 2012a)

### 2.5.1 FULL SERVICE FAMILY PRACTICE INCENTIVES SPECIFIC TO CHRONIC DISEASE

Currently, three GPSC incentives are particular to the management of chronic disease. These are described in the GPSC Billing Workbook (General Practice Services Committee, 2012a). Firstly, *annual condition based chronic care bonuses* for diabetes, congestive heart failure, and hypertension are available to physicians who provide and document guideline based care for patients for whom they provided the majority of care over the preceding year. An additional chronic care bonus is offered to encourage care planning for patients with chronic obstructive pulmonary disease (COPD). \$125 is provided to the physician who submits a billing code associated with these services, except for the hypertension bonus, which yields \$50.

Secondly, *annual complex care management fees* award physicians \$315 for the development of a guideline-informed care plan with a patient who suffers from at least two of eight different categories of chronic illnesses including diabetes, congestive heart failure, neurodegenerative disorders (such as Parkinson's or Alzheimer's disease), chronic respiratory conditions, liver

disease, renal failure, ischemic heart disease, and cerebrovascular disease. By billing this incentive, the physician (or practice) accepts the responsibility of coordinating care for the patient for the ensuing calendar year.

Finally, a *mental health planning fee* entitles the physician to \$100 in return for development of a guideline-informed care plan with a patient with a confirmed DSM-IV Axis I diagnosis of sufficient severity and acuity to cause interference in activities of daily living. Again, by billing this incentive the physician (or practice) is accepting responsibility of providing longitudinal care for the ensuing calendar year.

When one or more of the complex care management fees, the mental health planning fee, or the annual chronic care COPD bonus is utilized, access to additional incentives designed to compensate physicians who provide further clinical consultation by telephone or email become available. The value of this incentive is \$15 and can be billed up to 5 times in 18 months after the initial billing is submitted.

To support practices in taking full advantage of the GPSC initiatives, including the CDM incentives described above, the GPSC launched an additional program in 2007. The Practice Support Program (PSP) was established to help physicians and medical office assistants improve practice efficiency through self-assessment, education and other forms of peer-led support.

#### 2.5.1.1 The Practice Support Program

In 2004-5, GPSC consultations with over 1000 GPs during Professional Quality Improvement Days (PQIDs) demonstrated that further support and training programs were required to bolster the provision of full service family practice in BC (MacCarthy, Kallstrom, Gray, Miller, & Hollander, 2009). In response, the Practice Support Program (PSP) was established to create and administer the required support services.

Four learning modules were initially developed in 2007, one of which focused on CDM (Dines, 2011). PSP now offers eight learning modules (General Practice Services Committee, 2012b). Each module entails three paid and Continuing Medical Education accredited half-day learning sessions

that take place over a six to eight week timespan. Between learning sessions, members of the PSP team visit participating practices to support them in implementing module teachings. PSP teams are comprised of physicians and medical office assistant (MOA) champions, quality improvement/change management professionals and data support resources from each BC health region (MacCarthy et al., 2009).

Echoing the CCM, the current CDM learning module emphasizes the development of patient registries and the implementation of planned recall (General Practice Services Committee, 2009). However, these are discussed in the context of a tool known as the Chronic Disease Management Toolkit (CDM Toolkit) (See Section 1.6.1). As the CDM Toolkit has been decommissioned in favor of electronic medical record (EMR) systems, the CDM learning module is currently being revised. *Thus, there is currently no quality improvement/education program designed to support EMR-equipped practices with chronic disease management practices.*

In evaluations to date, the initial PSP learning modules seem to have had a positive effect. By 2009, approximately one third of BC's family physicians and their staff had participated in a learning module (Cavers, Tregillus, Micco, & Hollander, 2010); by 2011 the number increased to 55% (Dines, 2011). 89% of family physicians who completed the CDM learning module agreed that it enabled them to improve patient care (General Practice Services Committee, 2010). Evaluations of other learning modules have also shown success (General Practice Services Committee, 2010).

### ***2.5.2 EFFECTS OF THE GPSC INCENTIVE PROGRAMS***

In an evaluation completed in June, 2009 by Hollander Analytical Services it was reported that physician use of the GPSC incentives was positively correlated with patient attachment, and that patient attachment (where a patient receives at least 50% of services from a single GP) resulted in a 2007/8 cost avoidance of \$85 million for high-need patients with diabetes and congestive heart failure (General Practice Services Committee, 2010). Similarly, the COPD incentives were found to offer \$10 million in cost avoidance in 2009/10 (General Practice Services Committee, 2011). Costs avoided include GP and specialist services, diagnostics, hospital, and pharmacy costs. Moreover, physicians who are high billers of incentives increase the number and percentage of patients for

whom they provide the majority of care (Hollander & Tessaro, 2009). However, the Complex Care incentives have not been shown to produce cost savings. An evaluation of the incentive type produced in 2010 demonstrates that, after adjustment, cost of caring for incentive-billed patients actually increases by almost \$300 per patient compared to non-incentive billed patients (Hollander & Tessaro, 2010). In 2009/10 a loss of \$30-\$37 million dollars was estimated by the program evaluators. Still, when one considers the total effect of the incentive program, the effect on cost avoidance is positive.

In terms of physician uptake of the GPSC incentives, over 90% of family physicians are now billing for one or more incentives, 88% are billing for chronic disease incentives, and 70% are billing annual complex care fees (General Practice Services Committee, 2010; Mazowita & Cavers, 2011). Patients billed for incentives in 2007/8 ranged from 35 to 968 between physicians in the bottom and top quartile respectively, with billings increasing with each year that the physician uses incentives (Hollander & Tessaro, 2009). It has been approximated that physicians who bill for all incentives can increase their income by about 12%, or \$27 000 annually (Mazowita & Cavers, 2011). No factors have been reported on that describe characteristics of physicians or practices that utilize incentives at a high rate.

More generally the aggregate set of GPSC initiatives, including the incentives and other programs, have been favorably regarded by family physicians and BCMA members as illustrated by several surveys and interviews (General Practice Services Committee, 2010; Mazowita & Cavers, 2011). The ratio of full service family doctors to the more general family physician has increased from 62% in 2005/6 to 74% in 2007/8 (CHSPR, 2009). The incentives, trust building activities, and training and support services of the GPSC are seemingly restoring full service family medicine provision in British Columbia (Mazowita & Cavers, 2011). The current 2007 Physician Master Agreement, which, among other things, defines the budget and role of the GPSC expired in spring 2012. After a ratification in the fall of the same year, a new agreement was struck with the GPSC being allotted new funds in order to continue its mandate of enhancing the provision of full service

family practice (British Columbia Medical Association, Medical Services Commission, & Ministry of Health, 2012).

A noted challenge for physicians who participate (or wish to) in the GPSC incentive program is the complexity of the fee schedule (Mazowita & Cavers, 2011). Each fee code has a number of criteria which describe characteristics of the patient, the physician and the nature of the care that is to be provided to qualifying patients, including at what times and under what circumstances the care acts can take place in order to qualify for the associated incentive. Online and newsletter communications, as well as peer-led seminars, have been used to support physicians and their practices in navigating the fee schedule. Additionally, the PSP learning modules, while they don't address billing directly, support pursuit of administrative and practice management efficiencies and which may assist with incentive management.

Another tool recognized as important by the proponents of the GPSC in the use of incentives, and of chronic disease management in general, is the **electronic medical record** (EMR) system as it supports registry creation and recall initiation. However, physician feedback to the GPSC and PSP has indicated that further help is needed in integrating these EMR systems into their practices (Mazowita & Cavers, 2011).

## **2.6 CLINICAL INFORMATION SYSTEMS FOR CHRONIC DISEASE MANAGEMENT**

Recall that according to the CCM, successful CDM requires clinical information systems that support creation and maintenance of disease registries, as well as enabling patient surveillance using reminders, alerts, and other forms of integrated decision support. The first clinical information systems designed for this purpose in BC, the Probabilistic Disease Registries and the CDM Toolkit, are described below.

### *2.6.1 PROBABILISTIC DISEASE REGISTRIES*

In 2002, under the auspices of the province's Chronic Disease Management initiative, the Ministry of Health developed patient registries for diabetes and congestive heart failure. These probabilistic registries employ administrative data from the Medical Service Plan (e.g. outpatient physician and

laboratory services), Pharmacare and hospital discharge databases to identify patients with the target conditions. The intent is to establish prevalence, utilization costs, and set the stage for performance monitoring regarding CDM. At the outset, individual physicians did not have access to the system, although interest in this was expressed by the physician community (Ministry of Health, 2002). Registries were eventually developed for other conditions including chronic kidney disease, asthma, and osteoarthritis. As of 2012, the registries track 30 different conditions. Annually, the Ministry of Health's Primary Care branch produces "mini-profiles" that are sent to each primary care physician in the province. These profiles employ registry data from previous years to describe a given physician's practice population (as determined by a set of criteria known as the Majority Source of Care (MSOC)) including the prevalence of chronic conditions. A more detailed "Physician Patient Profile Report" can be requested from the Ministry's Primary Health Care branch. This report provides identifiable patient data and lists all of the physician's MSOC patients who, according to algorithms of the probabilistic registry, are believed to have a given chronic illness. Studies that speak to the utility and validity of this report have not been published, and anecdotal evidence encountered by the author suggests that little research has been conducted in this regard.

### *2.6.2 THE CHRONIC DISEASE MANAGEMENT TOOLKIT*

Also in 2002, the Ministry of Health introduced a CDM website with links to resources for patients, health care professionals and health administrators regarding the management of chronic disease (Ministry of Health, 2002). Linked from this CDM website were BC Clinical Practice Guidelines and Protocols to aid health care professionals in providing evidence based care. Developed by the Guidelines and Protocols Advisory Committee (GPAC) – a committee of the Medical Services Commission with representatives from both Ministry of Health and the BCMA - the guidelines included a Diabetes Care Patient Flow Sheet intended to support care by ensuring that certain care objectives were performed and documented. Over time flowsheets were created for a number of chronic diseases including depression, heart failure, stroke, and COPD. These flow sheets would later come to serve as the record of care for the chronic disease initiatives of the Full Service Family Practice Incentive program.

By 2003, physicians were able to use a secure portion of the CDM website to access disease registers for their patients with diabetes, congestive heart failure, and hypertension. Additionally, physician-specific performance indicators that described the number and proportion of patients receiving guideline based care were made available. Physicians, or their MOA delegates, could audit the disease registries to add additional patients or remove patients identified in error. In 2004, an extension to the CDM website known as the “CDM Toolkit” provided physicians with the ability to document care online by filling in GPAC designed patient flowsheets for registry added patients. Flowsheets could be shared with members of the group practice and reports available within the Toolkit used the data to generate recall lists, patient profiles, and practice profiles indicating how completely guideline based care was being provided (BC Health Services, 2004). The Toolkit, the CDM website, and other related CDM efforts were funded in part with proceeds from Health Canada’s Primary Health Care Transition Fund which supported primary health care renewal from 2000-2006 (Health Canada, 2007).

A 2006 analysis of the first use of the CDM Toolkit by a collaborative of thirty physicians on Vancouver Island reported significant improvements in diabetic care (Green, Fortin, Maclure, Macgregor, & Robinson, 2006). *Most critical to the success of the collaborative was the fact that it operated within a quality improvement (QI) framework.* Within this QI framework several other factors including *well-organized quarterly learning sessions, strong clinical and IT leadership and support, adult education informed knowledge translation activities, and suitable incentives* were identified as critically important. That is, the presence of the information system (the Toolkit) alone was recognized as a necessary, but not sufficient, factor for the successful CDM initiative.

The CDM Toolkit and website satisfied several elements of the expanded CCM – Clinical Information System, Delivery System Design, Decision Support, and Health System Reorganization. However, these CDM tools existed in a standalone system; they required that physicians (or their delegates) document flow sheet data into the provincially maintained online system. For paper based practices, this meant that in many cases information was first documented on paper copies of the flow sheet during the clinical encounter and later transcribed into the online system. For those

practices using EMRs *and* the CDM Toolkit, it was also necessary to perform dual data entry to take advantage of the unique reports and comparative features offered by the Toolkit. This would change in 2007 when a program was initiated to encourage province wide EMR adoption.

By 2008, there were approximately 1000 Toolkit users in BC and other provinces including Saskatchewan, Manitoba and the Yukon adopted the Toolkit (Kallstrom, 2008). However, with the widespread effort to introduce EMRs in BC starting in 2007 the CDM Toolkit registry and reporting functionality became somewhat redundant as many of the features were replicated within accredited EMRs. Thus, as of June 2012 the CDM Toolkit has been decommissioned (Ministry of Health, 2011d).

### *2.6.3 ELECTRONIC MEDICAL RECORD SYSTEMS FOR CHRONIC DISEASE MANAGEMENT*

With the financial stability of a long term federal health transfer plan resulting from the 2003 First Ministers' Accord on Health Care Renewal together with monies from the associated Health Reform Fund and the newly established Canada Health Infoway, BC was able to create and move forward a provincial eHealth strategy.

In 2005, BC's eHealth Strategic Framework put forward a plan to action the recommendations from federal and provincial bodies to invest and implement eHealth, which was viewed as an important enabler of a more efficient and cost-effective health care system (British Columbia eHealth Steering Committee, 2005). This strategy documents states that at the time, only 9% of family physicians were equipped with EMRs. And of these 9%, only one-fifth were using them to support practice recall, practice analysis or perform disease management. *The ten-year goal was to have the majority of physicians managing chronic disease aided by comprehensive electronic records that employed "system messages and flags to initiate regular tests and planned visits, based on clinical best practices and evidence-based guidelines"* (British Columbia eHealth Steering Committee, 2005, p. 23). *Moreover, these systems would provide practice-level analysis and aid in identifying patients with certain conditions, in addition to supplying the evidence to help treat them.* Although, not referenced by the strategy document, these aims aligned well with that of the expanded CCM.

In 2006, the Physician Information Technology Office (PITO) was created by the BCMA and the Ministry of Health to oversee the adoption of EMRs by all physicians in BC. With an initial budget of \$107.8 million, it was anticipated that half of the province's 8,000 physicians (i.e. all physicians including specialists and FPs) would be encouraged to adopt EMRs by the term ending March 31, 2012 (Ministry of Health, 2007b).

In 2007, PITO issued a Request for Proposal inviting EMR vendors to submit their EMR systems and undergo conformance testing so as to become an eligible EMR provider with access to interested PITO physicians. As part of the RFP, conformance specifications were provided that detailed the specific functionalities an eligible EMR must possess. As per the eHealth Strategy, the chronic disease functionalities of the CDM Toolkit were to be integrated into the EMR, and thus EMR vendors were provided with the conformance specifications that outlined the flowsheets, reports and registry functionality a conforming EMR must exhibit (Ministry of Health, 2007c). As of December 2008 five EMR vendors passed conformance to become "PITO Qualified" (Physician Information Technology Office, 2008). However, when Egton Medical Information Systems (EMIS) decided to cease Canadian operations, only four PITO qualified vendors remained – Osler Systems, Intrahealth Canada, Med Access, and Wolf Medical Systems.

A 2010 article by PITO Program Director, Jeremy Smith, states that of 3700 full service family physicians, EMR adoption was highest in large practices of six or more physicians (90%, or 1100/1230 physicians), moderate in practices of two to five physicians (50%, or 616/1230 physicians), and very low in solo practices (7%, or 86/1230 physicians) (Smith, 2010). In total, this represents EMR adoption in about half of all family physicians. It is unclear if physicians who had adopted EMRs prior to PITO are included in these totals. No further information has been made available that indicates adoption by family physicians has increased substantially since this 2010 publication.

With PITO approaching the end of its initial term, limited evidence is available that addresses the overall value of, or efficiencies gained by, the BC EMR investment. PITO policies state that within 12 months of implementation PITO-funded clinicians must be using the EMR to a minimum level

which includes *maintenance of problem lists, prescriptions, complete encounter notes for all patients, as well of use of reminders for recall, and reports to support population health* (Physician Information Technology Office, 2009). It is unclear if these targets are being met. It is also unclear how audit or surveillance in this regard would even be possible. Commentary by PITO Director Smith suggests that there is a wide degree of variation in how extensively EMRs are being used among PITO-supported family practices (Smith, 2011a). To address this variation, PITO is in the process of piloting a Post Implementation Support Program (Smith, 2011a). Through peer mentor super-users, creation of new practice support roles (Practice Automation Coaches), funding for advanced training and other means, this program intends to provide support to enhance the degree to which EMRs are used to support intelligent practice, which would naturally include provision of CDM care.

## **2.7 SUMMARY: SUPPORTING PROVISION OF CDM SERVICES BY EMR-EQUIPPED FAMILY PHYSICIANS**

In 2005, the BC eHealth Steering Committee set a ten-year goal to have the majority of physicians managing chronic disease aided by comprehensive electronic records that employed “system messages and flags to initiate regular tests and planned visits, based on clinical best practices and evidence-based guidelines” (British Columbia eHealth Steering Committee, 2005, p. 23).

As reported by evaluators of CCM-derived CDM programs, clinical information systems complete with disease registries, computerized reminders and guideline-incorporated, registry-linked patient assessment and planning tools are all critical to the efficient delivery of CDM care. BC FPs have had access to these tools since 2002, first in the form of the CDM Toolkit, and later through EMRs made more accessible by provincial initiatives such as that of the BCMA in PITO. However, as noted by CCM evaluators, and discovered again by evaluators of the first CDM collaborative in BC, the presence of clinical information systems are, while necessary, not entirely sufficient to foster improvements in CDM care. Additional critical enablers are necessary.

Two such enablers include compelling financial incentives and an overarching quality improvement framework complete with strong clinical leadership, regular learning opportunities and adult education informed knowledge translation activities. The GPSC’s CDM incentive program and the

PSP's quality improvement-oriented CDM learning module could be said to qualify as embodiments of these respective CCM enablers. Uptake of the GPSC incentive program appears high, and the program appears to be having some positive effect in increasing cost-avoiding patient attachment. However, since the retirement of the CDM Toolkit there has been no quality improvement program available to address CDM care provision in the context of the new clinical information system paradigm of the EMR. Thus, one major enabler of effective CDM care is missing.

A third critical enabler of success for CCM-enactors is the presence of *clinical system support and consultation services*, especially for small family practices. In this regard, BC's PITO is in the early days of determining what level of support is necessary, and what forms of support are most desirable and effective. And for non-PITO adopters of commercial EMRs, non-vendor support is simply unavailable. While anecdotal evidence exists to suggest that EMR use is highly variable between family practices, little has been published about the degree to which EMRs have been *meaningfully* adopted (provincially or nationally), nor about how efficiently they support FPs in their CDM practice. Similarly, little evidence has been made available that offers guidance on effective EMR support tactics, especially in a context that features incentivizes.

If we are to meet the ten-year goal set by the eHealth Steering Committee in 2005 to support CDM through effective use of electronic medical record systems, it would appear that we need to bolster our ability to identify, develop and deliver the types of EMR support that are most needed.

### 3 UNDERSTANDING, EVALUATING AND ENHANCING EMR

#### ADOPTION IN INCENTIVIZED GENERAL PRACTICE CONTEXTS

##### 3.1 INTRODUCTION

As discussed, delivery of effective CDM care may be enhanced with use of clinical information systems that allow for the maintenance of disease registries; alerts and recalls that ensure eligible patients are provided with timely care; and, evidence-informed flowsheets and templates to assist in thorough point-of-care consultations. EMRs, in the context of BC, are required to provide such functionality. However, it is left to the individual physicians to a) opt to provide CDM services as part of his/her practice and b) adopt EMR functionality as a means to support such a practice. While it has been demonstrated that additional measures such as financial incentives, clinical system support, and quality improvement activities may further facilitate an effective CDM practice, it is not well understood whether typical, EMR-equipped primary care practices in BC are enticed by such incentives or are in need of programs to provide clinical system support or quality improvement opportunities.

To investigate these phenomena the researcher will use a mixed methods design informed by several frameworks and exemplary projects from the literature. These are detailed in the following sections. Detailed discussions of the study design as well as the chosen methods to employ the frameworks are provided in the next chapter.

##### 3.2 UNDERSTANDING FACTORS THAT IMPACT EMR ADOPTION

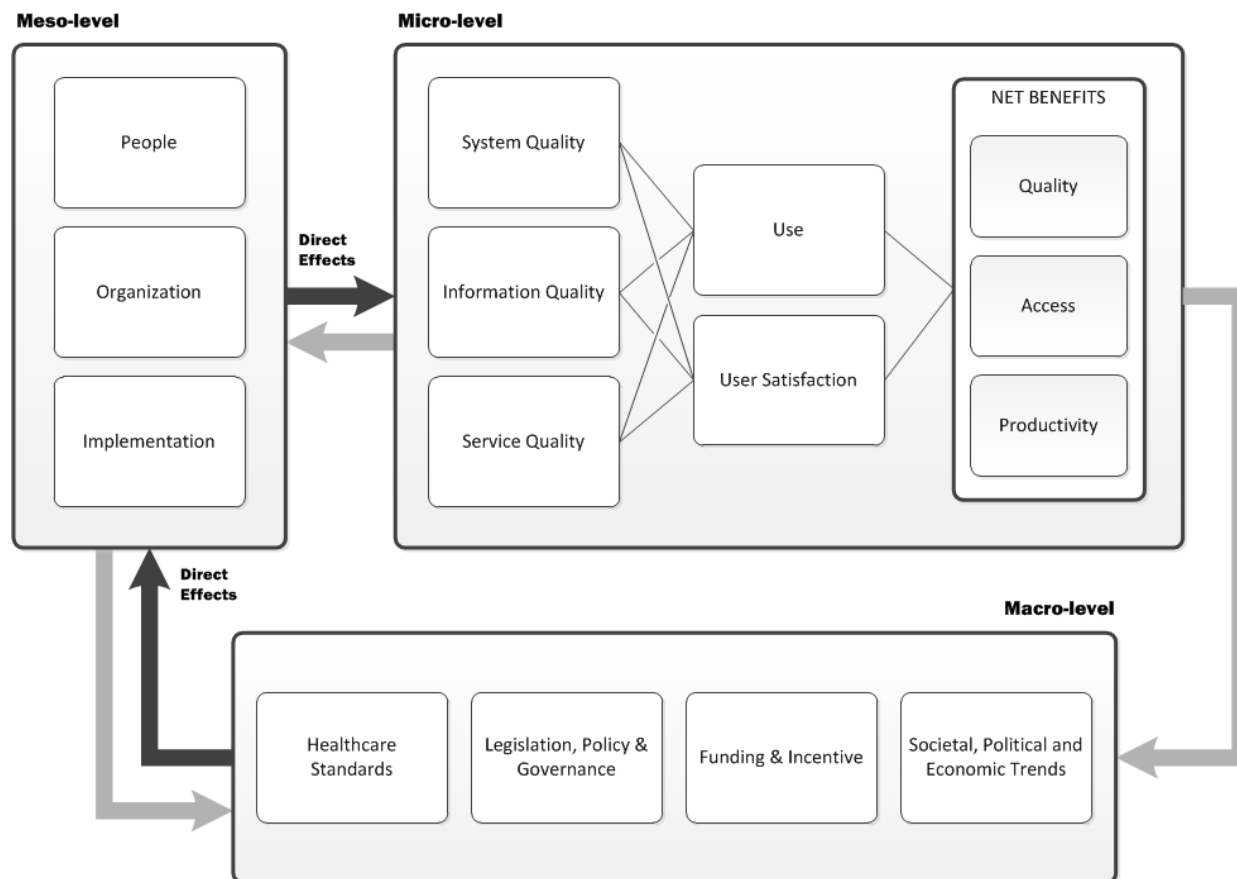
The Clinical Adoption Framework (CAF) introduced in 2009 by Lau et al provides a three-tiered collection of contextual forces that combine to influence adoption of health information systems (Lau, 2009). Seen in

Figure 1, these factors include at the micro-level *system characteristics* including System Quality, User Satisfaction and Net Benefits (as adapted from the updated Delone and Maclean Information Systems (IS) Success Model (2003)); at the meso-level the *people, organization* and *implementation manner* involved in administering and using the system; and, at the macro-level wider environmental forces of *standards, incentives, policy* and *trends*. A CAF-guided health information system evaluator is encouraged to use a variety of tools to thoroughly catalog and explore the diverse range of forces that independently, and in aggregate, encourage and detract from system uptake and success.

While the micro-level tier of the CAF has been used extensively in information system research, its application in health care is relatively new (Forland, 2007, p. 18). However, since Canada Health Infoway's adoption of the adapted IS Success Model in 2006 in its own Benefits Evaluation Framework, evaluations of health information systems using the micro-level tier of the CAF are emerging (Canada Health Infoway & eHealth Observatory, 2012). At the time of study design, the meso and macro tiers of the CAF have yet to be applied in published research. However, guidance by Lau et al. (2011; 2009) offers many measures that may be used to design and perform evaluations within these dimensions. As a core intent of this research was to understand how meso- and macro- level forces, particularly incentives, drive EMR adoption and provision of EMR-enabled CDM services, the CAF was used as the guiding theoretical framework for organizing and interpreting study findings.

**Figure 1: The Clinical Adoption Framework with its micro, meso and macro dimensions**

(Lau et al., 2011)



### 3.3 ASSESSING LEVELS OF EMR ADOPTION

For the purposes of this research, the concept of EMR adoption referred to the degree to which the various components of the clinical information system have been incorporated into the practice of clinical and administrative users. A 'high' level of adoption not only implied that a large portion of the EMR functionality was being regularly utilized, but that the functionality was being used in a manner that allows for performance of complementary activities such as reliable use of decision support, data interchange with other clinical systems, automated practice surveillance, and research. By this definition, the regular practice of using the EMR to identify, document and improve the care of chronic disease patients would be considered one indicator of a high level of EMR adoption. While implementation of EMRs in Canada hovers around 56%, recent evidence

suggests that only 14% of adoption can be considered high (Dermer & Morgan, 2010; Schoen et al., 2012).

In an attempt to standardize assessments of EMR adoption, researchers from the University of Victoria's eHealth Observatory created the EMR Adoption Framework (AF) complete with a series of evaluation tools in the EMR Evaluation Toolkit (eHealth Observatory, 2012a; Morgan Price, Lau, & Lai, 2011). The EMR AF and the associated tools enables an evaluator to perform a series of evaluation exercises with the EMR, the EMR vendor and the various EMR users to derive a score, from zero to five, that is reflective of overall adoption (See Table 3). The five adoption stages are consistent with those proposed by the Healthcare Information Management Systems Society (HIMSS) as well those that have since been adopted by BC's PITO (HIMSS Analytics, 2009; Smith, 2011b). One EMR Evaluation Toolkit tool in particular, the EMR Adoption Survey allows the assessor to collect information on ten facets of EMR use, including use of functionality related to registries, reporting, guideline access, visit documentation templates and flowsheets – all of which, as described already, are key technologies to supporting an effective CDM practice (eHealth Observatory, 2012b). The use of the EMR Adoption Survey enabled the researcher to engage with the practice physicians on the issue of EMR utilization so as to subjectively understand 1) the ways in which the EMR was being used, and 2) the enablers and barriers affecting use – both at baseline and post-intervention.

**Table 3: The EMR Adoption Framework Five stage model of EMR Adoption**

**(Morgan Price et al., 2011)**

Stage	Description
5	Full EMR that is interconnected with regional/community hospitals, other practices, labs and pharmacists for collaborative care. Proactive and automated outreach to patients (e.g., chronic disease management). EMR supports clinical research.
4	Advanced clinical decision support in use, including practice level reporting. Structured messaging between providers occurring within the office/clinic.
3	Computer has replaced paper chart. Laboratory data is imported in structured form. Some level of basic decision support, but the EMR is primarily used as an electronic paper record.

<b>2</b>	Partial use of computers at point of care for recording patient information. May leverage scheduling/billing system to document reasons for visit and be able to pull up simple reports.
<b>1</b>	Electronic reference material, but still paper charting. If transcription used, notes may be saved in free-text/word processing files.
<b>0</b>	Traditional paper-based practice. Charts on paper, results received on paper. May have localized computerized billing and/or scheduling, but this is not used for clinical purposes.

### **3.4 MEASURING DATA QUALITY AS A MEANS TO ASSESS EMR ADOPTION**

Central to the ability to provide comprehensive CDM care services is the ability to identify all patients within a population that have a chronic condition of interest. As summarized by Bowen and Lau (Bowen & Lau, 2012), Canadian primary care researchers and secondary data users have demonstrated that extracted EMR data is often not of sufficient quality for such a purpose. That is, the EMR data is incomplete, inconsistently formatted, inaccessible, or otherwise unfit for use in creating and maintaining a reliable disease registry. An EMR that contains disease data of poor quality not only disrupts the ability to maintain a disease registry, but renders unreliable the use of additional EMR reports, alerts, and other decision support that rely on quality condition list data. Thus, without sufficient data quality, it is not possible to adopt EMRs to a high degree - poor EMR data quality imposes a ceiling on EMR utility. It is this connection between EMR data quality and EMR adoption that was to be exploited by the researcher in order to provide a complementary and objective perspective of EMR adoption by a general practice. Evaluations of EMR data quality have been used by other primary care researchers to investigate elements of EMR-enabled care delivered in general practice including validity and utility of disease registers (Brown & Warmington, 2002, 2003; CHDGP Project Team, 1997; de Lusignan, Chan, Stevens, et al., 2005; de Lusignan, Chan, Wood, et al., 2005; Falconer & de Lusignan, 2004; Hogan & Wagner, 1997; Horsfield P., 2002; Ivers, Pylypenko, & Tu, 2011).

In 2011/12, the researcher conducted an informal review of techniques and measurement dimensions used in evaluations EMR data quality in the literature (Bowen & Lau, 2012). It was concluded that no consistent data quality definitions or approach to data quality evaluation exists.

Similar conclusions have been expressed by both earlier and later reviewers (Chan, Fowles, & Weiner, 2010; Jordan, Porcheret, & Croft, 2004; Thiru, Hassey, & Sullivan, 2003; Weiskopf & Weng, 2012). Thus, in collaboration with colleagues in the eHealth Observatory, a framework for conducting EMR-based evaluations of data quality was created (Bowen & Lau, 2012). This framework outlines seven data quality dimensions and corresponding measurement techniques (see Table 4), as well as an overall process that may be used to guide EMR data quality evaluations (see Table 5). A review of electronic health record data quality assessment definitions and techniques, published after the research had been initiated, demonstrates significant overlap between measurement dimensions and techniques suggested by the eHealth Observatory framework and those popular in the literature, thus offering some degree of validation for the approach (Weiskopf & Weng, 2012).

**Table 4: eHealth Observatory EMR Data Quality Dimensions**

<b>Data Quality Fitness Dimension</b>	<b>Evaluation Intent</b>	<b>Measurement Technique</b>	<b>Metric</b>
<b>Completeness</b>	Is the data free from significant gaps in coverage that may otherwise limit its ability to represent the true state of affairs?	Data extraction & analysis	Sensitivity (%)
<b>Correctness</b>	Does the data accurately describe the true state of affairs it is intended to represent?	Data extraction & analysis	Positive Predictive Value (%)
<b>Concordance</b>	Is the data in relative agreement with other relevant reputable sources?	Data extraction & comparison of findings against reputable reference	Data in relative agreement with cited reputable source (Y/N)
<b>Comprehensibility</b>	Is the average intended reviewer able to understand the data so as to be able to attempt to infer the author's intended interpretation of the true state of affairs?	Clinical Panel Review	% of records where a majority of reviewers were able to understand the recorded data
<b>Informative</b>	Does the body of available data	Clinical Panel	% of records where the

<b>sufficiency</b>	adequately support <i>an inference</i> of the true state of affairs by an average intended reviewer irrespective of any objective level of completeness, correctness or consistency?	Review	majority of reviewers were successfully able to infer all important clinical elements
<b>Consistency of Capture</b>	Are the desirable data elements consistently recorded?	Observation, Interview, and/or Data extraction	% of eligible records, or representative sample, that contain the data item of interest
<b>Consistency of Form</b>	Are the data elements consistently captured in the desirable form?	Observation, Interview, and/or Data extraction & analysis	% of eligible records, or representative sample, that contain the data item(s) of interest in the desired format

**Table 5: eHealth Observatory 10 step method for designing and executing a context sensitive data quality evaluation**

<ol style="list-style-type: none"> <li>1. Identify an activity that relies on the use of EMR data.</li> <li>2. Through observation and interview become familiar with the context in which the activity is carried out. Determine its intent, identify the EMR data which are most critical and become familiar with the tools and people involved in the activity's performance.</li> <li>3. Determine what tool(s) or resources are available to interrogate the EMR quality data. Reconcile that the data elements used by the tool are the same as those identified as important for the activity – i.e. ensure alignment between important data, documented data, and tool-accessible data.</li> <li>4. Determine what fitness dimensions are most important for each data element to exhibit (see Table 4). Provide a sense of the desired or acceptable level of fitness in relation to the intent of the activity.</li> <li>5. Select an associated measurement technique for the selected fitness dimensions (see Table 4).</li> <li>6. Customize each measurement technique according to the findings of Step 2. If necessary, use one or more <i>data quality probes</i> (Brown &amp; Warmington, 2002, 2003) to further inform the design of case selection or query construction.</li> <li>7. Apply the techniques using the tools and/or resources identified in Step 3.</li> <li>8. Report the fitness of each data element independently according to the measures defined in Table 4.</li> </ol>
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9. Describe how the overall fitness of each important data element combined enhances or impairs the ability to perform the activity of interest. This is data quality *in context*.
10. Present the data quality findings. Attempt to provide feedback on how data quality and utility of each contributing data element might be improved.

(Bowen & Lau, 2012)

### **3.5 ASSESSING ADOPTION VIA ANALYSIS OF EMR UTILIZATION**

Through evaluations of data quality, the researcher hoped to develop an understanding of how practice level EMR adoption was bolstered and/or compromised by the quality and utility of data held within the EMR. An additional method employed to quantitatively understand EMR adoption is analysis of utilization data as represented within audit logs.

Very few studies that use audit log data to assess clinical information system utilization are found in the literature (Bowes, 2010; Dullabh, Moiduddin, & Babalola, 2010). However, a study by lead by Intermountain Healthcare's Senior Medical Informaticist, William Bowes (2010), made use of hospital information system audit logs to determine the range of system functionality that had been accessed by various hospital departments. Audit logs, while not designed to support assessments of adoption, often contain details such as functionality interacted with; date of access; and, associated patient and practitioner identifiers. Analysis of such data might be used to reveal trends in use of certain EMR functionality, including those functions especially relevant to the delivery of CDM care services.

### **3.6 ASSESSING INCENTIVE USE VIA ANALYSIS OF EMR ADMINISTRATIVE DATA**

To explore the relationship between EMR adoption levels and CDM incentive use, it was necessary to be able to deduce the extent to which incentives are utilized. Analysis of administrative data – specifically fee-for-service billing data submitted via the EMR to the BC Medical Service Plan by practice physicians – has been used to develop descriptive statistical accounts of the number of incentivized-linked CDM services that have been billed in a given time period. Although derived from a central claims database, rather than from EMRs directly, this approach was used by

Hollander et al's evaluation of the CDM incentive program to determine rates of incentive utilization by BC family practices (Hollander & Tessaro, 2009, 2010).

Moreover, administrative billing data can be useful for the identification of patients with chronic conditions of interest, as demonstrated in studies such as those of Tu and colleagues, as well as the algorithms employed by the BC probabilistic registries (Ministry of Health, 2012a; Tu, Campbell, Chen, Cauch-Dudek, & McAlister, 2007; Tu, Mitiku, Lee, Guo, & Tu, 2010). In this way, EMR billing data was felt to provide an alternative and supplemental avenue to that of clinical data (held within Problem Lists, for example) for the detection of disease subsets within a family practice – an important capability being that the intent was to provide feedback on the extent of CDM incentive utilization respective to the burden of disease in a given practice population.

### **3.7 ENABLING IMPROVEMENTS IN EMR ADOPTION AND INCENTIVE UTILIZATION**

With the assumption that analysis of EMR adoption levels and incentive utilization rates would reveal opportunities for improvement, the researcher worked to develop a quasi-experimental quality improvement (QI) intervention to encourage positive change in these areas. As noted by evaluators of the BC CDM Toolkit, the successful integration of CDM tools in general practice was enhanced when delivered in the context of a QI framework (Green et al., 2006). An intention of this research was to explore how an intervention focused on the improvement of *data quality* might result in subsequent improvements in EMR adoption and CDM incentive utilization.

Over a period of eight years, the UK-based Primary Care Data Quality (PCDQ) programme demonstrated that a large number of practices could be engaged with feedback, education, and “gentle” inter-practice competition to improve both EMR data quality and quality of care for various diseases including ischemic heart disease, atrial fibrillation, and chronic kidney disease (De Lusignan, 2007). Also demonstrated were improvements in EMR documentation rates for smoking cessation, smoking status, aspirin usage, and cholesterol measurement (De Lusignan, Hague, Brown, & Majeed, 2004). The PCDQ programme is well described in the primary care informatics literature with papers available that describe methods for: organization of a data quality improvement project (De Lusignan et al., 2004; de Lusignan, 2007); processing primary care data

for auditing purposes (Van Vlymen, De Lusignan, Hague, Chan, & Dzregah, 2005); assessing data quality (Faulconer & De Lusignan, 2004); and, providing effective feedback (De Lusignan, 2005). Thus, the PCDQ process is rather amiable to replication, albeit some modifications may prove necessary when applied in the context of a Canadian general practice.

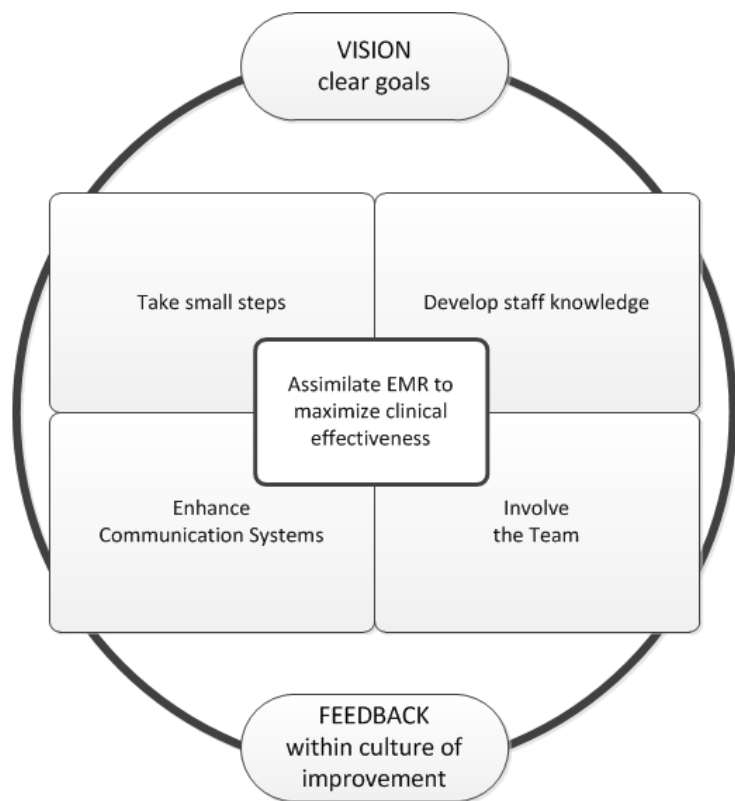
Also supportive of the notion that data quality feedback can lead to improved EMR-enabled practice, especially in the context of financial incentives, is a UK practice whereby data quality consultants are employed to assist general practices with optimized delivery of incentivized care services. These consultants assist practices by conducting audit and analysis of locally held data; by providing feedback designed to highlight opportunities for service delivery improvements; and, by providing education and support to improve local knowledge of clinical terminologies, EMR-related reporting tools and general information management practices. Since the introduction of the incentive-rich performance program known as the Quality Outcomes Framework in the UK, which coincided with the introduction of these data quality professionals, dramatic increases in recording of associated clinical data has been observed (McGovern et al., 2008; Simpson, Hannaford, Lefevre, & Williams, 2006; Simpson, Hippisley-Cox, & Sheikh, 2010; Sutton, Elder, Guthrie, & Watt, 2010a). For the past 12 years, UK health care data quality professionals received training and access to analytic and feedback tools from the Primary Care Information Services (PRIMIS) group – a collective of researchers, informaticians and clinicians at the University of Nottingham specialized in collection, promotion and use of high quality primary care data (The Health and Social Care Information Centre, 2012). The PRIMIS Director collaborated with the PCDQ lead to author a summary of characteristics that comprise an effective data quality improvement initiative (De Lusignan, 2005):

1. Motivation of professionals to have a positive attitude of their structured computer data
2. Working with lead clinicians receptive to evidence-based quality improvement initiatives
3. Respect for the “clinical judgement” (phronesis) of experienced clinicians
4. Using informatics as an enabler of quality improvement
5. Using education as an appropriate change agent

6. Data quality feedback using parameters with a positive predictive value and high sensitivity
7. Personally provided feedback, by a skilled facilitator, within the workplace
8. Professionally led programmes, supporting local clinical champions
9. Alignment with national, evidence-based, quality improvement programme
10. Financially incentivised

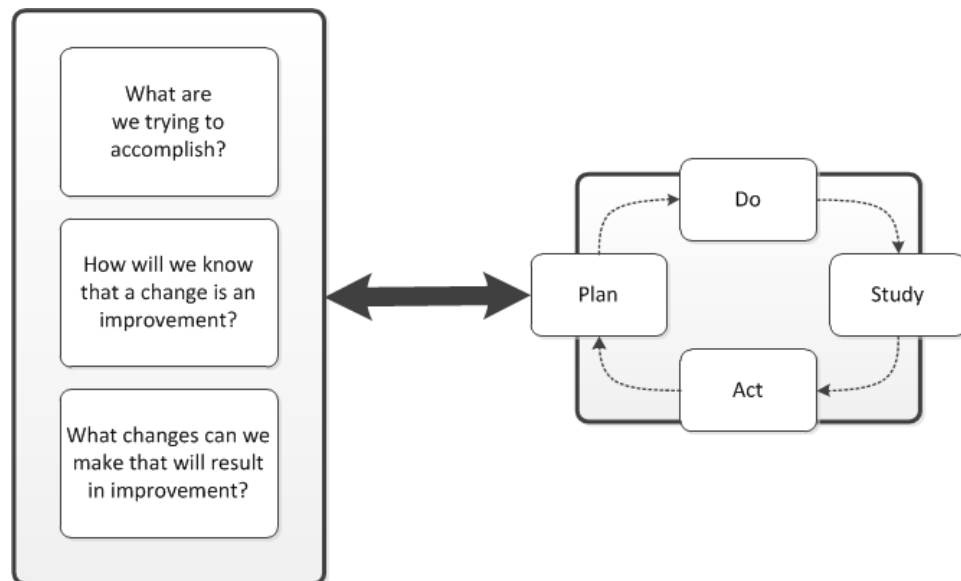
Broader quality improvement frameworks not specific to improvements in EMR adoption or data quality provide further guidance that was used to inform the design of effective quality improvement interventions. For example, the Practice Partner Research Network's (PPRN) *Translating Research into Practice* (TRIP) model for QI (see Figure 2) presents a tested strategy for encouraging positive change in primary care practices using EMRs (Nemeth, Feifer, Stuart, & Ornstein, 2008). Broader still, the *Model for Improvement* employed by the Institute for Health Improvement (see Figure 3) in numerous Breakthrough Series projects (including many projects focused on primary care improvements in chronic disease management and used to inform the construction of the Chronic Care Model) provides general guidance on how to organize a QI initiative (Institute for Healthcare Improvement, 2003). In addition to offering general QI guidance, these tested frameworks offer some validation for the tactics employed within the PCDQ and PRIMIS QI initiatives. For example, strategies of the TRIP model including recommendations to "take small steps," "develop staff knowledge" and "assimilate the EMR into practice to maximize clinical effectiveness", are echoed in specific PCDQ/PRIMIS tactics such as opting to focus on improvements for only one or two conditions at a time; use of adult-oriented education to induce change; and, motivating practices to have a positive view of structured EMR data with use informatics as an enabler for change (De Lusignan et al., 2004; Teasdale & Bainbridge, 1997). Furthermore, *Model for Improvement* advice to *identify specific outcomes to change* and *identify appropriate measures to track success* align well with PCDQ/PRIMIS tactics to identify specific and achievable clinical objectives and select feedback parameters with a high positive predictive value and sensitivity (De Lusignan, 2005).

**Figure 2: The PPRN-TRIP model for quality improvement**



(Nemeth et al., 2008)

**Figure 3: The Model for Improvement employed by the IHI**



(Institute for Healthcare Improvement, 2003)

## 4 METHODOLOGY

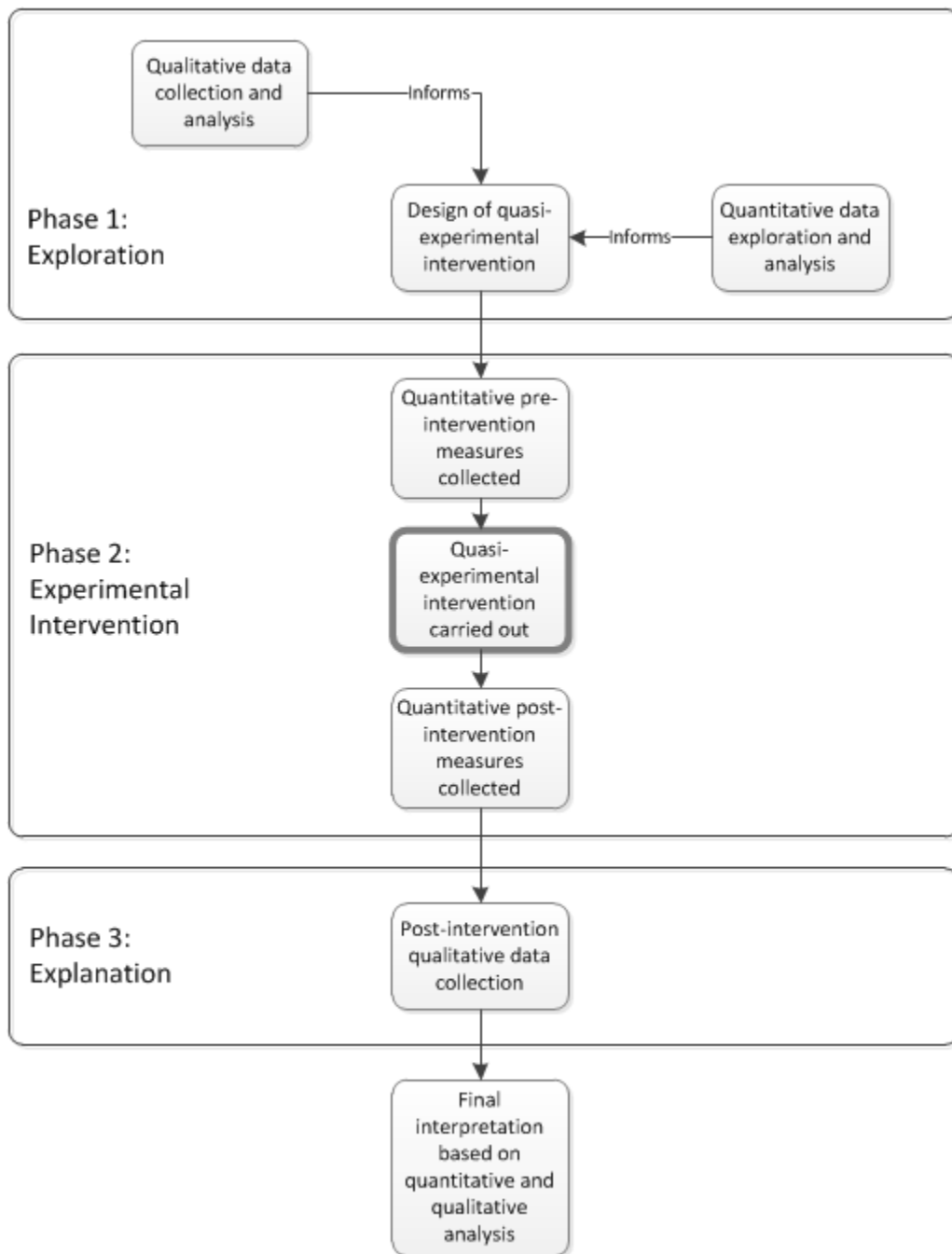
### 4.1 RESEARCH DESIGN

This study employed an embedded mixed methods design. Generally, a mixed methods design is characterized by the collection, analysis and mixing of qualitative and quantitative data in a single study under the premise that combined use of the data will provide a better understanding of the research problem (J. Creswell & Clark, 2010, p. 5). As described by Creswell and colleagues (2004), variants of the mixed method design have been used in primary care settings to explore topics such as guideline adherence, information needs of terminally ill patients, and effectiveness of prevention programs. An *embedded* mixed methods design implies that one set of data is used in a supportive, secondary role in a study based on another, primary data set. In this study, a variant of the embedded mixed methods design known as the Embedded Experimental Model was employed (J. Creswell & Clark, 2010, p. 69). In this specialization of the design, a preliminary set of data is collected and analyzed to inform the design of the quasi-experimental intervention. Then, following the intervention, a second data set is collected and analyzed to support interpretation of the quasi-experimental results. Figure 4 provides a visual depiction of the sequential three phase embedded experimental model design used in this study.

In the Canadian context, contemporary phenomena such as EMR adoption, EMR data quality and chronic disease incentive use are relatively understudied, especially when one looks to understand relationships between each phenomenon. The researcher, wishing to understand how these phenomena interact in the multivariate “real-world” of primary care opted to execute this mixed methods study within a single BC family practice. Here, the researcher was able to explore in depth the social, political, technical and cultural context in which the research phenomena of interest interact while staying within time and resource constraints. While the findings from a single site study might not generalize to the larger BC family practice community, it was the intent of the researcher to contribute to a body of knowledge of how to pursue such research on a larger scale in the future.

To guide data collection in the first exploratory phase of the mixed methods study, theoretical propositions inspired by the CAF were used to guide and inform instrument development. Like hypotheses in experimental study designs, these propositions suggest expected study outcomes.

**Figure 4: Embedded Design - Embedded Experimental Model**



Relevant to this study, the major proposition suggested by the CAF is that the existence of an incentive program (i.e., a macro-level intervention) will exert some effect on micro-level EMR system adoption and that such changes will be detectable in the intermediate, meso-level entities of People, Organization and Implementation. A second proposition is that the sophistication of practice level EMR adoption will affect the extent of incentive utilization. To test such propositions, it was necessary to deduce both EMR adoption levels and levels of incentive utilization. To deduce levels of EMR adoption at the practice, a triangulation of data from multiple instruments was employed - these are the EMR Adoption Survey, a CAF-inspired interview, analysis of EMR audit logs, and evaluations of EMR data quality and utility. Insight into the extent of practice level incentive use was derived mainly from analysis of administrative (i.e., billing) data from within the EMR as well as additional CAF-inspired interview responses. At the end of the exploratory phase, the researcher was able to verify whether the planned intervention did indeed make sense in the context of practice incentive utilization rates, EMR adoption levels, and attitudes towards the provision of incentivized CDM care. Moreover, the exploration of EMR data and refinement of methods to assess EMR data quality, incentive use, EMR feature use and so on, further informed the design of the envisioned intervention.

While the first phase of the study explored propositions related to incentive use and EMR adoption levels through a variety of instruments including interview, survey and quantitative analysis of data held in the EMR, a second phase of inquiry investigated a specialization and extension of these propositions by means of a quasi-experiment. Unlike the more general CAF-inspired propositions that EMR adoption levels and incentive programs exert mutual effects, the quasi-experiment hypothesized that they are indeed positively correlated and can be manipulated via feedback. That is, the research hypothesis tested by the quasi-experiment proposes that a family practice that is made aware of incentive under-utilization will seek to adopt an EMR to a greater degree as a means to claim a greater portion of said incentives. Stated another way, the null hypothesis was that feedback describing under-utilization of incentives will not result in changes in EMR adoption and/or incentive utilization.

Following the “same -group pre-test/post-test” design (Harris, 2005) a series of measures were taken in advance of the feedback intervention and re-measured post-test to detect possible intervention effects. In the quasi-experiment, interpretations of EMR adoption were made through analysis of EMR data quality and feature utilization audit logs, while extent of incentive utilization was again determined through analysis of EMR billing data. As described earlier, methods from a successful and well-published UK-based clinical and data quality improvement programme (the PCDQ) was used to inform the design of feedback and data analysis activities of the quasi-experiment.

As a same-group pre-test/post-test design with no randomization into control and experimental groups, it was not possible to assign causality of any detected effects to the intervention itself (Harris, 2005). However, the quasi-experiment allowed the researcher to test the feasibility of an intervention without extensive resources. Moreover, if some degree of correlation was observed between feedback, incentive use and EMR adoption then further research into the reasons for those correlations may be warranted.

Finally, in the third phase of the study, the researcher sought to collect additional qualitative data from the quasi-experiment participants as a means to further account for any observed correlation. This was done via a post-intervention focus group discussion.

It was the hope of the researcher that insights into the phenomena being investigated and the results of the quasi-experiment might prove useful in developing more rigorous future investigations and informing scalable EMR-related quality improvement activities.

A summary of the study design components that were used to explore the major research questions, including the primary propositions and hypotheses, is provided in Table 6.

**Table 6: Research Questions and associated components of the research design**

<b>Research Question</b>	<b>Associated component of research design</b>	<b>Proposition/Hypothesis</b>
1. How does the presence of CDM incentives affect EMR adoption in a BC family practice, and conversely how does the extent of EMR adoption impact the delivery of incentivized CDM care?	Exploratory mixed methods analysis	<ul style="list-style-type: none"> <li>• Incentives do exert some effect on EMR adoption</li> <li>• EMR adoption levels do exert some effect on utilization of incentives</li> </ul>
2. Might a program of EMR data analysis, feedback and provision of EMR support positively impact subsequent EMR adoption and delivery of incentivized CDM care by a BC family practice?	Quasi-Experiment/ Post-intervention focus group discussion	<ul style="list-style-type: none"> <li>• Feedback that demonstrates incentive under-utilization will result in increases in EMR adoption and/or subsequent incentive utilization</li> </ul>

## 4.2 ETHICAL APPROVAL

An application for ethical review was submitted to the University of Victoria's Human Research Ethics Board in January of 2012. Ethical approval was provided on April 10, 2012 prior to the start of any research activities (Ethics Protocol Number: 12-021). The Certificate of Approval is provided in Appendix A.

## 4.3 RECRUITMENT

Locating family physicians interested in participating in research activities is a well-known barrier to conducting research in the primary care domain (Borgiel et al., 1989; Fulda et al., 2011; Goodyear-Smith et al., 2009; Wetzel et al., 2005; Young, Dehaven, Passmore, & Baumer, 2006). With limited time to locate interested practices, the researcher employed convenience sampling techniques. Recruitment activities were performed by a Victoria-area family physician known to the researcher as active in supporting EMR-equipped practices in the local area. Use of "clinical champion" physician recruiters is a successful recruitment tactic employed often in primary care based research (Asch, Connor, Hamilton, & Fox, 2000; Fulda et al., 2011).

The researcher first met with and discussed the objectives of the research with the family physician. In addition, a list of recruitment criteria was provided. These criteria called for a family practice that:

- Comprised of 2-5 fee-for-service family physicians.
- Was at least two years into the implementation of an EMR system. The EMR system in use would be one of the five EMR systems recognized by PITO as being in conformance with provincial EMR standards.
- Had an interest in examining how completely they provide enhanced, incentivized services to qualified patients in the practice population.
- Had an interest in exploring how well the data in the practice EMR supports the provision of enhanced, incentivized services to qualified patients in the practice population as well as some interest in improving both data quality and provision of enhanced services.

The family physician contacted various family practices in the local vicinity known to him, introduced the focus of the project and passed along contact details for the researcher in the event the family practice was interested in participating in the research. As a result of the recruitment efforts, one practice contacted the researcher. The researcher engaged the practice further to provide a more detailed description of the study. Ultimately, the practice agreed to participate.

#### **4.4 SETTING**

The setting of this research project was a single EMR-equipped, multi-physician primary care family practice in the province of British Columbia. The practice was considered typical in that a PITO-conformed EMR is in use at the practice; the services provided by the clinic were typical of a BC full service family practice; the practice physicians operate under the status-quo fee-for-service payment scheme; and, the practice had no history in participating in EMR or CDM research or quality improvement activities such that they held atypical levels of interest or altered practices regarding data collection, EMR use, or provision of CDM care.

#### **4.5 PARTICIPANTS**

Primary study participants were the practice family physicians. However the practice's lead medical office assistant did attend feedback and discussion sessions. All participants provided written, informed consent to participate in the study. In addition, the researcher entered into a both confidentiality and data sharing agreements with the practice physician in order to provide an additional level of confidence that data under the care of the physicians would be treated in a manner that would not compromise patient rights to privacy and confidentiality.

#### 4.6 TIMING

The following table outlines the sequence of research activities undertaken by the researcher.

**Table 7: Sequence of research activities**

Task	Expected Time	Participants	Inputs	Output
<b>Pre-intervention (May - June 2012)</b>				
A. Qualitative data collection	1 hour	Researcher, Practice Physicians	A. CAF inspired questionnaire B. EMR Adoption Survey C. List of incentives and associated diseases	1. Subjective account general attitudes towards EMR tools, EMR data quality, and incentive program 2. EMR Adoption scores and associated subjective data 3. Select diseases/incentives to use in subsequent analysis
B. Qualitative data collection #2: Observation	1 hour x 2	Researcher, Practice Physician	D. Observation Checklist	4. Record of local strategies for CDM with EMR
C. Quantitative data collection #1	1 week	Researcher, EMR Vendor, Practice Physician	E. #3 F. EMR query strategy, informed by #4 G. Access to EMR data, or EMR data extract	5. Anonymized EMR data set permitting for analysis of incentive utilization, EMR feature utilization, disease prevalence estimation and data quality
D. Quantitative analysis #1	2 weeks	Researcher	H. #5 I. Initial query strategy J. Initial data	6. Iteratively refined query strategy 7. Refined assessment goals

			assessment goals for utilization, prevalence, and data quality	8. Disease prevalence by practice and physician roster 9. Incentive utilization by practice and physician 10. Measures of data quality 11. EMR feature utilization statistics
E. Feedback Intervention (Presentation & Discussion)	1 hour	Researcher, Practice Clinicians, Practice Administrator	K. #8-10 incorporated in presentation	12. Feedback artifact 13. Intervention started 14. Initial goals and ideas for facilitating improvement
<b>Post-Intervention Support (July - October 2012)</b>				
F. Post-intervention support	As needed over 4 months	Researcher, Practice Physician	L. #13	15. Provision of any EMR/informatics support deemed necessary
<b>Post-Intervention Analysis (November - December 2012)</b>				
G. Quantitative data collection #3	1 week	Researcher, EMR Vendor, Practice Physician	M. Select EMR data needs to satisfy re-measurements of items #8-10	16. Anonymized EMR data set #2 permitting for analysis of incentive utilization, EMR feature utilization, disease prevalence estimation and data quality
H. Quantitative data analysis #2	2 weeks	Researcher	N. #6-12, #16	17. Changes in disease prevalence, incentive utilization rates, data quality, EMR feature utilization
I. Presentation of post-intervention analysis and focus group discussion	1.5 hours	Researcher, Practice Clinicians, Practice Administrator	<ul style="list-style-type: none"> <li>#17 incorporated in presentation</li> <li>Debrief Evaluation topic sheet</li> </ul>	18. Record of evaluation of data quality feedback intervention
J. Report Writing	2 weeks	Researcher	<ul style="list-style-type: none"> <li>All items</li> </ul>	19. Final Report

## 4.7 DATA COLLECTION

### 4.7.1 INTERVIEWS

A single, two-part interview was used to: 1) collect the physicians' self-reported accounts of their respective levels of EMR adoption, and 2) collect subjective views on the CDM incentive program, EMR satisfaction, notions of EMR data quality and the role of EMR and its data in supporting incentive use. Interviews lasted 30-45 minutes. Notes were taken and interviews were recorded.

Firstly, EMR adoption data was collected using the aforementioned eHealth Observatory EMR Adoption Survey (<http://ehealth.uvic.ca/resources/tools/emradoption/EMRAAdoption.php>).

Subjective data on issues of the CDM incentive program, EMR satisfaction, EMR data quality and the relationship among these phenomena was collected in the second half of the interview. A list of interview questions (see Appendix B: Clinical Adoption Framework Interview Questions) was devised by the researcher using the CAF constructs and tailored questions derived from the CAF-recommended "Reactive Analysis for Evaluating Information Systems" (Silver, Markus, & Beath, 1995, p. 376) and Kotter's Organizational Change Model (see <http://ehealth.uvic.ca/methodology/metrics/metrics.php#section0-33>). The CAF-inspired questionnaire focused on understanding first how the CDM program was perceived by the practice physicians and whether it resulted in any changes, or intentions to change, among the meso-level domains of People, Organization, or Implementation. A further line of questioning investigated whether those meso-level changes resulted in subsequent changes in views or priorities within the micro-level domains of the System Use, perceived System Quality, Service Quality, Benefits, and so on. The intent was to understand, subjectively, whether macro-level forces of incentivization and standards indeed exerted sufficient influence to inspire changes in the meso-level; whether the micro-level system entity was understood to be an enabler of such change; and whether the experience of trying to enact such change resulted in a broadening in the perception of micro-level system characteristics crucial to success – for example, increased appreciation for the use of standard terminologies and altered views on what comprises quality data.

#### *4.7.2 OBSERVATION*

During or after interviews the researcher asked each physician to demonstrate how the EMR was used to support various aspects of CDM service provision – most notably capture of patient

conditions, generation of disease registries, issuing of recalls, and use of relevant reminders and alerts. The observation session was audio recorded and notes were taken throughout.

#### *4.7.3 EMR ORIENTATION AND DIRECT EMR INTERACTION*

In addition to having relevant EMR functionality demonstrated by practice physicians, the researcher received an orientation to the EMR by the EMR vendor and was provided access to online training materials. These materials included specific reference to the relevant topics of condition recording, CDM documentation, registry generation, and various EMR reporting mechanisms. These materials were referenced by the researcher throughout the study to support analysis and generation of feedback content.

The EMR vendor also provided the researcher with login privileges for the practice EMR. The account was fully auditable by both the practice and the EMR vendor. On four occasions the researcher, under supervision of the practice staff, used the login to access the local EMR for the purposes of exploring the reporting interface and learning more about the tools available to support CDM service provision.

#### *4.7.4 EMR DATA EXTRACT*

On recommendation by the EMR vendor that a data extract would best support analytic efforts, the researcher was twice provided an anonymized copy of the EMR dataset of the practice – once in to establish performance and adoption baselines, and again post-quasi-experiment to establish any intervention effects. The extract was made available as an SQL database and was securely transferred and encrypted on the researcher's computer. This process of transfer and encryption took place within the confines of the EMR company headquarters. The vendor was not able to provide documentation to inform the researcher on the data model of the EMR extract as no such documentation existed. However, a brief orientation to the data extract was provided at the time of the first transfer. Moreover, the vendor provided additional data extract information to the researcher in subsequent email correspondence.

#### *4.7.5 POST-INTERVENTION FOCUS GROUP DISCUSSION*

After the final post-intervention round of data analysis, the researcher returned to the practice to provide physicians with feedback on observed changes in incentive utilization and facets of EMR adoption including EMR data quality and EMR feature utilization. In addition, the researcher asked a series of questions designed to draw out physician views on the usefulness and motivating effects of the feedback program (see Appendix C: Post-Intervention Focus Group Discussion Questions). This session was audio recorded and notes were taken throughout.

## **4.8 DATA ANALYSIS**

### *4.8.1 INTERVIEWS*

#### 4.8.1.1 Analysis of CAF-focused interview results

Notes and audio recorded sessions from each CAF-focused interview were reviewed. Using manual content analysis, and the macro-, meso-, and micro-level elements of the CAF as the concepts of focus, both concept existence and frequency of mention was documented. Emphasis was placed on understanding interactions between dimensional components of the CAF and to what extent, if any, a given dimensional force incited change in other framework areas.

#### 4.8.1.2 Analysis of EMR Adoption Survey results

Scores collected on the EMR Adoption Surveys of each physician were tallied using the Microsoft Excel scoring template provided by the eHealth Observatory (<http://ehealth.uvic.ca/resources/tools/emradoption/EMRAoption.php>). Notes and audio recordings were used to review individual scores in order to ensure that scores captured during the interview were supported by comments made during the interviews. EMR Adoption scores were calculated for each physician, as well as for the practice as a whole.

### *4.8.2 OBSERVATION, EMR ORIENTATION AND DIRECT INTERACTION*

Notes collected during EMR observations and interactions were reviewed to inform development of strategies that could be used to collect EMR data for analysis of CDM and EMR feature utilization; execute EMR data quality queries; and improve delivery of EMR-enabled provision of CDM services.

### *4.8.3 EMR DATA EXTRACT*

Each of the two EMR data extracts were analyzed using a combination of Microsoft SQL Server Management Studio, Microsoft Access and Microsoft Excel. Being that no EMR data model was provided to the researcher, and that limited vendor assistance was available to aid the researcher in becoming adept at using the data set, the researcher conducted an exploratory analysis of the initial EMR data extract so as to familiarize himself with the various data tables, table relationships, stored procedures, and anonymized data content available to support construction of queries to estimate EMR feature utilization, incentive utilization, and EMR data quality. Eventually, it was deemed feasible by the researcher that relevant descriptive statistics could be provided for the set of measures described in Table 8. Values for each of these measures were calculated twice, using pre- and post-intervention data extracts. Simple descriptive statistics were then used to describe any changes in pre- and post-intervention measures.

**Table 8: Measures used to inform quasi-experiment intervention construction and results comparison**

1. General characteristics of practice population by practice and physician
  - a. Roster size estimates
  - b. Disease prevalence estimates
    - i. Diabetes, COPD, and Congestive Heart Failure (CHF) (2007-2011)
    - ii. Disease combinations pertinent to Complex Care incentive program (2011-12)
2. Incentive utilization by practice and physician
  - a. Annual incentive earnings (2007-2011)
    - i. Diabetes, COPD, CHF and Hypertension bonuses
    - ii. Complex Care Fees
  - b. Average monthly incentive earnings (2009-2011)
    - i. Diabetes, COPD, and CHF bonuses
    - ii. Complex Care Fees
  - c. Average number of patients provided incentivized service (2009-2011)
    - i. Diabetes, COPD, and CHF bonuses
    - ii. Complex Care Fees

3. EMR data quality by practice and physician
  - a. Consistency of Capture:
    - i. Percentage of patients where a Condition List entry of any kind was recorded
    - ii. Percentage of patients where an Allergy List entry of any kind was recorded
  - b. Consistency of Form:
    - i. Percentage of Condition List entries that employed an ICD-9 coded value
    - ii. Percentage of Prescribed Medication List entries that employed a coded value
  - c. Completeness:
    - i. Percentage of matching Condition List entries made for patients with apparent diabetes, COPD, hypothyroidism and CHF as indicated by prescribed medications or billing data
  - d. Concordance:
    - i. Level of relative agreement between disease prevalence figures for diabetes, COPD and CHF found in the EMR and those in the published literature
    - ii. Level of relative agreement between diagnoses captured in Condition Lists versus submitted billing claims
4. EMR feature utilization by practice and physician
  - a. Percentage of CDM patients for whom flow sheet instances were created
  - b. Percentage of reminders (i.e., “tasks”) created for CDM purposes
  - c. Number of times CDM Report functionality was accessed

#### *4.8.4 POST-INTERVENTION FOCUS GROUP DISCUSSION*

Comments offered by physicians during the final post-intervention discussion were transcribed and analyzed in order to identify themes which addressed the overall usefulness and motivating effects of the feedback initiative, as well as the primary enablers and detractors of any change efforts.

### **4.9 INTERVENTION**

A quasi-experimental intervention was executed at the family practice to test the hypothesis that CDM incentive utilization, EMR adoption and EMR data quality could be improved with the

provision of audit-based feedback and EMR support. Based on the experiences and published methods of the PCDQ programme and other QI frameworks previously described, and informed by the findings of the initial round of quantitative data analysis, a presentation was compiled and delivered to the practice in the context of a discussion and learning session. In advance of the intervention, a series of analyses were performed to produce pre-test measurements for the set of variables seen previously in Table 8.

Following the principles of the PCDQ programme and other QI frameworks, the presentation was designed to: 1) encourage small, but well defined, improvements, 2) be brief, 3) educational, but respectful of clinician expertise and experience, 4) promote a positive attitude toward structured data, 5) enable improved utilization of established financial incentives, and 6) encourage a “gentle” competition among practice physicians. The feedback portion of the intervention took place in late June with all physicians and the lead medical office administrator in attendance. The session was audio recorded and notes were taken. The intervention itself, as well as the list of support activities that followed, will be described in greater detail in the next chapter.

## 5 RESULTS

### 5.1 PRACTICE & PHYSICIAN OVERVIEW

A full service group family practice in Victoria, British Columbia agreed to participate in the research project having met all inclusion criteria. All four physicians receive payment via the typical fee for service remuneration program. The practice employs two full-time medical office administrators. The practice had been using an EMR since 2007, did not participate in the PITO EMR program, but did opt to implement an EMR supplied by a PITO conformant EMR vendor. Of the four physicians, one took primary responsibility for the maintenance of the EMR system. Table 9 provides further information about the family practice.

**Table 9: Practice/Physician Overview**

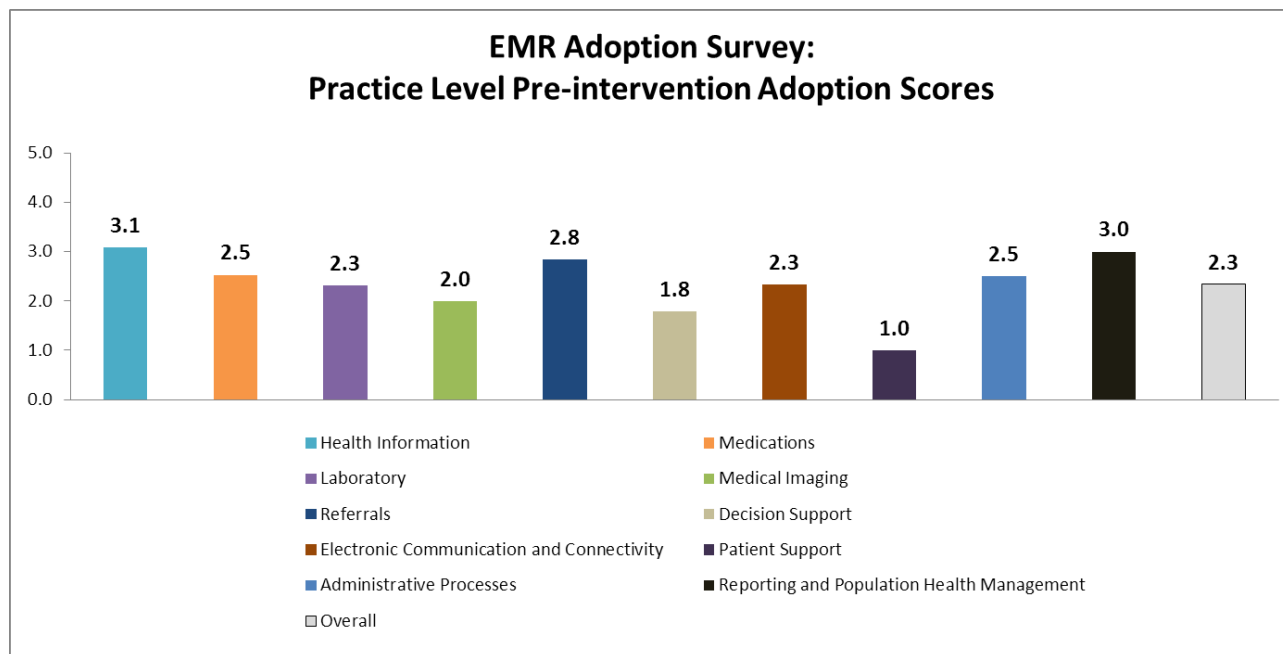
<b>Practice size - # of Physicians</b>	4
<b>Female Physicians</b>	1 of 4 (25%)
<b>Average physician roster size - 2011</b>	1057 patients (Min: 964/Max: 1213)
<b>Average # years in practice</b>	20 (Min: 8/Max: 34)
<b>Average # of years in EMR enabled practice</b>	5

### 5.2 PRE-INTERVENTION FINDINGS

#### 5.2.1 EMR ADOPTION LEVEL

The practice scored a 2.3 out of a possible five on the EMR Adoption Survey. Highest scores were in the categories of Health Information (3.1/5), Reporting and Population Health Management (3/5), and Referrals (2.8/5). Lowest scores were found in the Patient Support (1/5), Decision Support (1.8/5) and Medical Imaging (2/5) categories. See Figure 5 for an overview of all ten EMR adoption category scores. Individual EMR Adoption Survey scores are provided in Appendix D: EMR Adoption Survey Scores. Overall physician adoption scores varied from 2.1 to 2.7 indicating a similar level of adoption by all practice physicians.

**Figure 5: EMR Adoption Survey Practice Level Scores**



Of particular relevance to this study, the EMR adoption survey provided insights into the following facets of a CCM aligned, EMR-enabled CDM practice:

- **Clinical data capture:** 3 of 4 physicians were still maintaining some minimal form of a paper charting practice with medical summary information often being kept on a face sheet within the paper chart. This practice was declining however in favor of EMR-based documentation. Still, only one physician described a regular practice of using the structured Problem List to regularly capture patient conditions. All physicians stated that the bulk of clinical data was captured as a free text SOAP note in the EMR using voice dictation.
- **Accessing CDM evidence:** While the EMR features CDM templates with embedded evidence based guidelines, none of the physicians reported using such templates as a means of accessing clinical practice guidelines. Instead, each physician used alternative online clinical guideline resources.
- **Reminders:** All physicians reported making use of the EMR's "task" functionality as a way of manually creating reminders for follow-up. However, only one of the physicians reported

using such reminders as a means to facilitate recall of incentive-eligible chronic disease patients.

- **Flowsheets for documentation:** 3 out of 4 physicians stated that, in regards to managing chronic patients, they used an EMR with flow sheets that can be used to generate reminders and recall lists. However, not all physicians opted to use the flowsheets for all chronic conditions or all patients, with one physician opting to never use them.
- **Disease Registry:** All physicians stated the EMR can produce reports from billing data and/or problem lists, however only 2 of 4 physicians stated that they had done so.
- **Recall Lists:** 3 of 4 physicians acknowledged that the EMR was capable of running reports on the basis of billing, diagnostic and other clinical data. However, only one physician stated that he regularly used a financial report to identify and recall patients that had yet to be billed for annual CDM incentives. One physician regularly maintained a paper recall list for tracking CDM eligible patients.

### *5.2.2 CLINICAL ADOPTION FRAMEWORK FINDINGS: CDM INCENTIVES, EMR AND DATA QUALITY*

According to the CAF, EMR adoption is a product of many forces. Once levels of adoption were established, a CAF inspired line of questioning (Appendix B: Clinical Adoption Framework Interview Questions) proved useful in understanding *if* and *how* a given set of those forces encouraged adoption of a select set of system functionality – for example, how existence of standards and incentives encouraged use of the EMR to support provision of CDM services.

Interviews demonstrated that the macro-level incentive program was known to, and sufficiently understood by, all practice physicians. Knowledge of the program and the promise of increased revenue exerted sufficient influence to encourage the majority of physicians to seek ways to provide incentivized CDM services.

At the meso-level, the impacts of macro-level effects were evidenced by reported changes, or intents to soon implement change, in each of the related dimensions of People, Organization and Implementation. Physicians described altering work schedules to set aside time to conduct

searches for eligible patients and complete the extra documentation required for incentivized billing, as well as having front staff take on new clinical and documentation duties such as taking and recording blood pressure value related to the incentives. The practice reported that they had had considered adding new administrative staff if doing so would have a revenue-positive effect through better provision of CDM services. The majority of the practice reported that incentives were billed *opportunistically* when qualified patients presented on their own volition, but that they would like to institute more proactive CDM recall if time and optimized processes could be put in place. Finally, the practice physician primarily responsible for acquiring the EMR stated that a major driver for its acquisition was the belief that the system would enhance the practice's ability to capitalize on the CDM incentive program.

The desire to implement meso-level change was, however, somewhat diminished by two additional perceptions of the incentive program. First, all physicians described the documentation requirements of the incentive program as excessive, and in particular, did not appreciate being mandated by the GPSC to provide the hypertension and COPD-incentive eligible patients with copies of the relevant flowsheets and care plans regardless of whether the physician felt it would result in any benefit. Secondly, the majority of physicians reported some anxiety at the prospect of being audited by the Ministry of Health and having awarded revenue clawed back if it was found that either documentation was inadequate, not all incentive-related health targets were met (which, in fact, is not a condition of the incentive program), or patients reported not getting copies of related flowsheets or care plans. These views discouraged adoption of the incentive program and detracted from the desire to dedicate time and effort to implement new supportive processes.

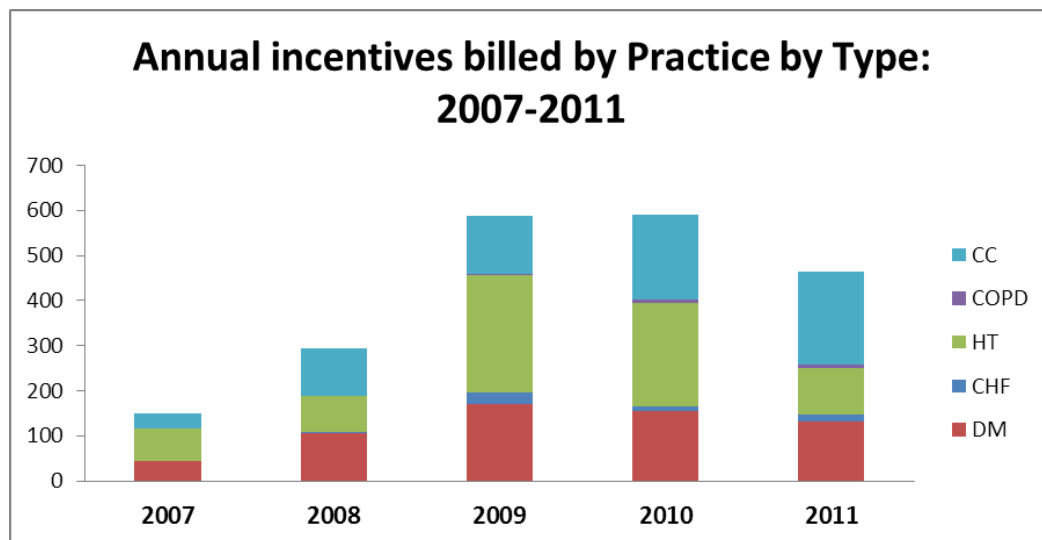
At the micro-level, practice members reported that they had experimented to some degree using documentation, reporting and recall functionality of the EMR related to the provision of incentivized CDM services. That is, meso-level intentions to enact process and organizational change were reported to propagate, to some extent, down to the micro-level. Physicians reported mixed levels of satisfaction with the EMR in terms of micro-level System and Information Quality, and high satisfaction with Service Quality. In terms of System Quality, while most physicians

reported using the EMR for documentation of Condition List entries and production of registers of chronic disease patients, most had problems in effectively using these pieces of functionality. In regards to challenges associated with capturing ICD-9 coded conditions, physicians attributed a small portion of problems to the poor usability of the EMR code selection interface. More significantly, they stated that the ICD-9 terminology was inadequately descriptive, cumbersome to navigate and of little clinical value. Because the physicians did not typically employ coded conditions they subsequently stated that most available EMR reports were of little value as they were designed with the expectation that codes would be used. As a result, reports that tended to be used were those that relied on billing, not clinical, data. All physicians felt that EMR Information Quality was adequate for support of day-to-day clinical activities, but in regards to its ability to support CDM, only two of the four stated that they had explored using system data for that purpose. Related to Information Quality, the concept of data quality did not seem to resonate with the physicians as few were able to offer adjectives or otherwise characterize what might be implied by the term. Finally, in regards to User Satisfaction, half of the physicians admitted that their levels of competency in using the EMR could be improved, while half felt that they had a complete grasp of the system. Still, all physicians expressed satisfaction with Service Quality in terms of provision of responsive support and training by the EMR Vendor and their physician partners.

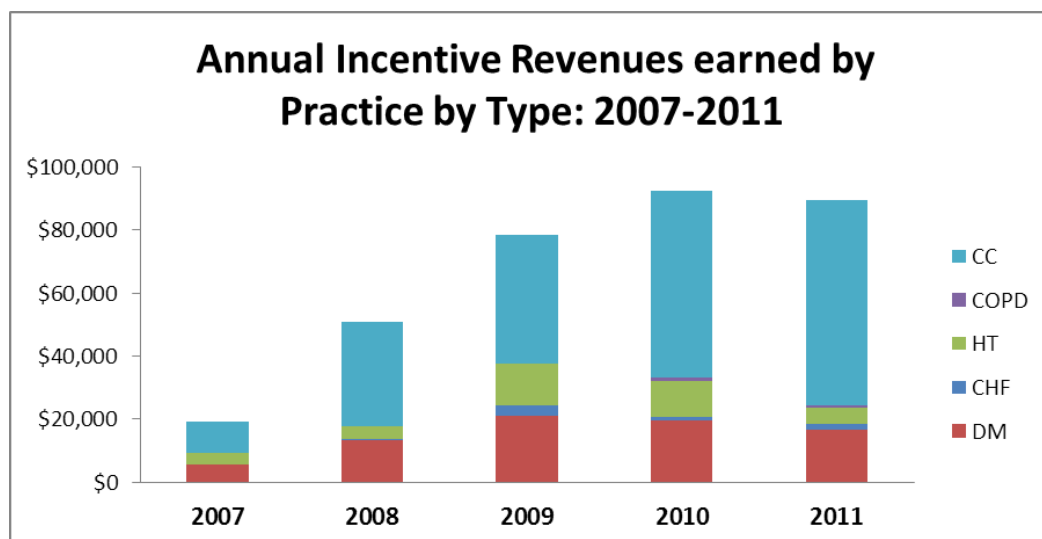
### *5.2.3 INCENTIVE UTILIZATION*

Analysis illustrated in Figure 6 reveals that the total number of incentives billed by the practice in the preceding five years plateaued by 2010, with a decrease in 2011 of 21.5%. However, the financial impact of lower incentive billing was minimized (i.e., declined by just 3.4% in 2011) as the practice shifted to billing a greater number of the higher yielding Complex Care (CC) services and less of the lower yielding Annual Chronic Care Bonuses (ACCBs), with the lowest yielding Hypertension bonus seeing the greatest reduction in utilization (see Figure 7). This reflects what some physicians reported during the subjective interviews.

**Figure 6: Annual Incentives billed by Practice by Type, 2007-11**



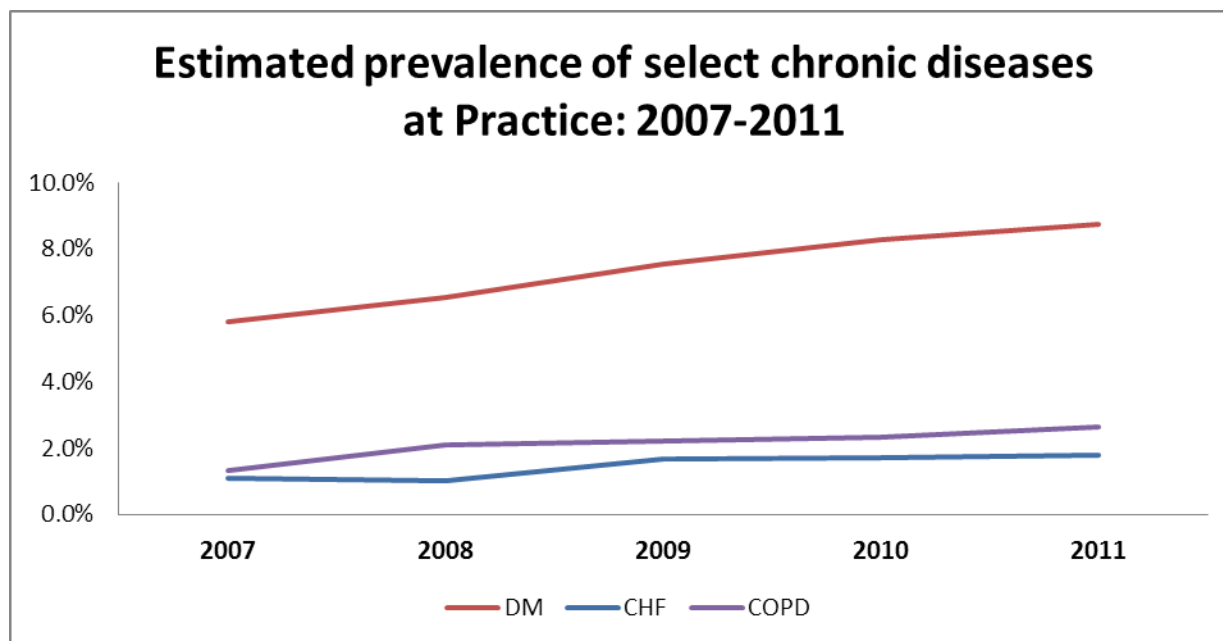
**Figure 7: Annual Incentive Revenues earned by Practice by Type, 2007-11**



To gain some insight into how completely incentivized care services were billed by the practice relative to select disease burdens, an analysis of diabetes, congestive heart failure (CHF) and COPD prevalence versus associated incentive use was performed. ACCB incentives have been available for diabetes and congestive heart failure since 2007, with the COPD bonus introduced in 2009. In the case of all conditions, incentives are under-utilized with respect to estimated prevalence. As

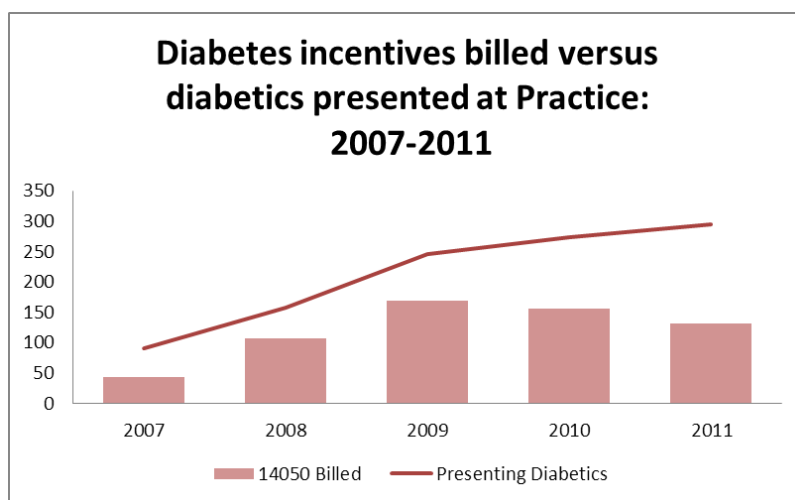
depicted in Figure 8, disease prevalence for all conditions appeared to increase over the period 2007-2011.

**Figure 8: Diabetes, Heart Failure and COPD Disease prevalence at Practice**



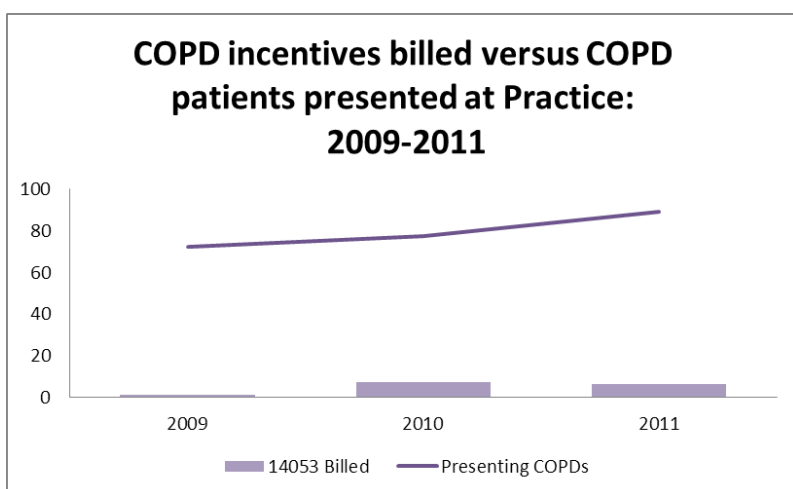
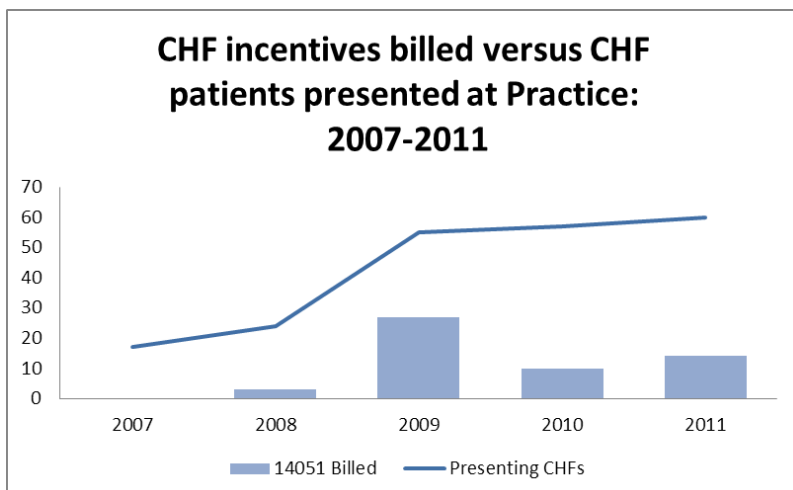
As illustrated in Figure 9, diabetes incentives were used at the highest rates – peaking at 69% of estimated prevalence in 2009. Congestive heart failure and COPD incentives were billed much less peaking at 50% and 9% of prevalence respectively. Assuming reliability in disease prevalence estimates (see EMR

**Figure 9: Incentive utilization versus select practice disease prevalence rates**



Data Quality discussion), the overall financial impact to the practice due to under-utilization of these three incentives is estimated at \$104,875 over the five-year period.

A corresponding analysis of physician level prevalence and utilization rates was performed. Results can be seen in Appendix E: Physician Level Prevalence and Incentive Utilization Rates. Similar trends were seen for each physician with diabetes incentives being used to the greatest extent, followed by those for congestive heart failure and COPD.

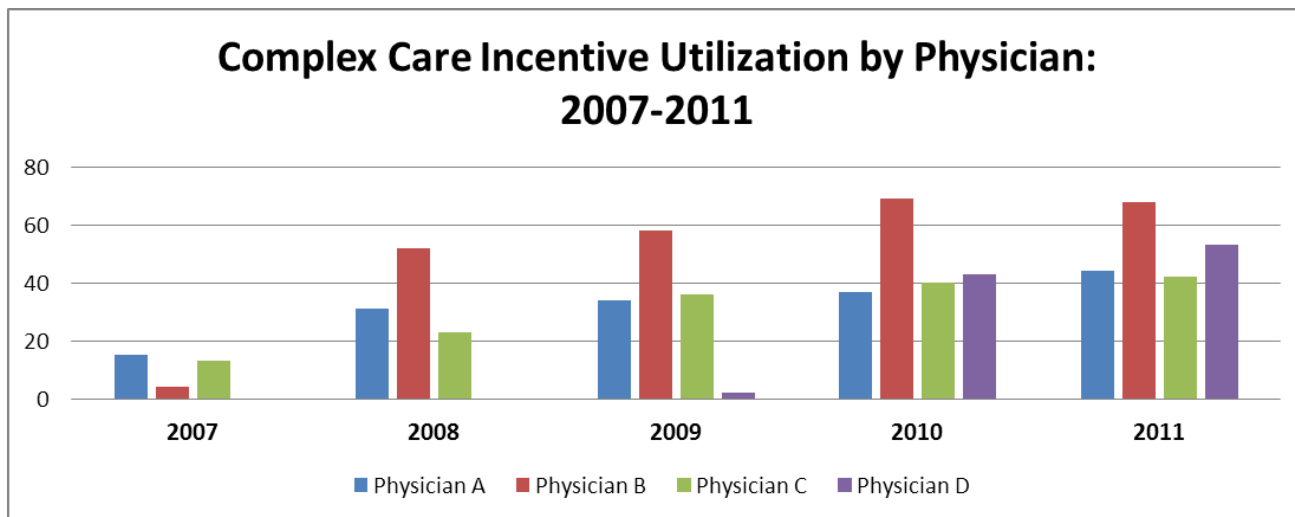


This analysis demonstrates that decreased use of ACCBs is *not* correlated with reductions in disease prevalence, i.e., reductions in opportunities to provide incentivized services.

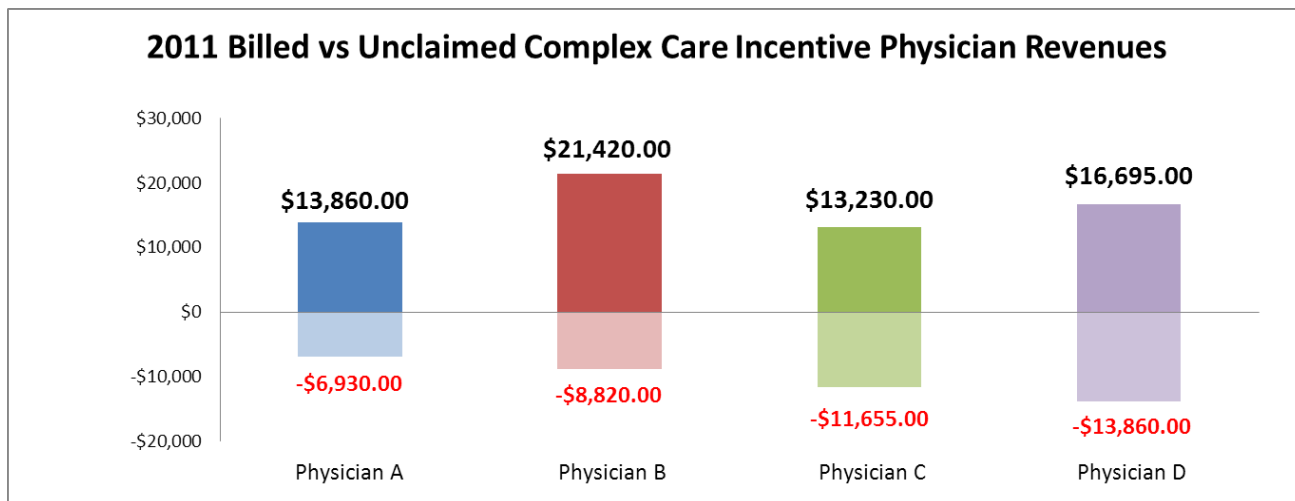
A similar analysis of the Complex Care (CC) incentive reveals that while the incentive type has been increasingly used each year since 2007 (see Figure 10) under-utilization in 2011 resulted in an estimated loss by the practice of \$41,265 (see Figure 11). Still, the 2011 utilization rate for the CC incentive was estimated to be 61% of prevalence, which is higher than any of the practice-level utilization rates for ACCB incentives. This finding confirms what was found during interviews that

some physicians were taking extra measures to ensure the more lucrative CC billings were submitted.

**Figure 10: Complex Care Incentive Utilization by Physician, 2007-11**



**Figure 11: Billed versus unclaimed Complex Care Incentive physician revenues**



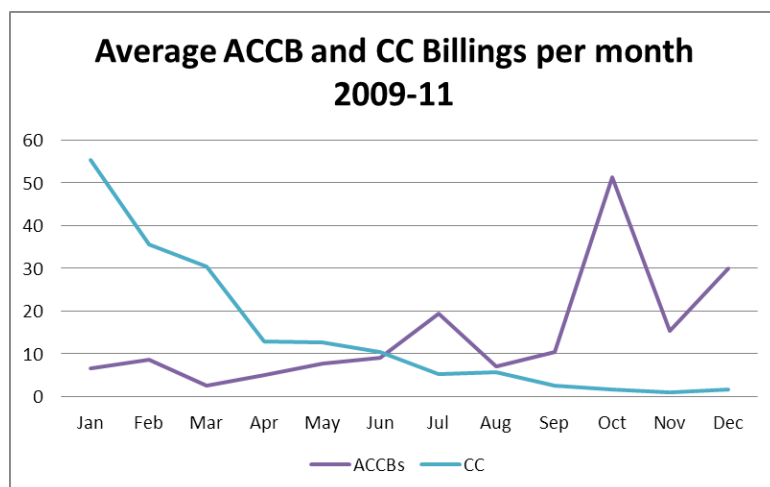
It should be noted that there was some difficulty in ascertaining utilization rates for the CC incentive due to the breadth of conditions that could qualify a patient for eligibility. As has been described, the CC incentive type covers a range of eight collections of diseases, including broad categories such as Neurodegenerative Disorders and Chronic Respiratory Conditions.

Unfortunately, the GPSC Billing Guides provide no guidance as to the specific diseases or ICD-9

diagnoses that might be included in each disease category. The EMR vendor, in designing EMR functionality to permit for identification of incentive-eligible patients assembled their own set of qualifying ICD-9 codes to be used for this purpose. The researcher reviewed this codeset, and on noting gaps in codes for chronic renal failure and various neurodegenerative conditions, added further ICD-9 codes to this codeset for the purposes of determining disease prevalence and incentive utilization rates. Still, in the absence of GPSC guidance, the final set of codes employed by the researcher may still have mis- or under-represented the set of diseases intended to be covered by the incentive program. Thus, the utilization measures calculated for CC incentives must truly be considered as estimates.

Once it was confirmed that practice-level incentive utilization was indeed sub-optimal, a final analysis was conducted so as to construct a series of baseline figures that could be used in conjunction with the planned quasi-experimental intervention in order to detect any post-intervention effect on incentive utilization.

It was first discovered that practice incentive utilization habits exhibited some seasonal tendencies; with CC incentives typically being submitted early in the year and the majority of ACCB billings submitted near the end of the year (see Figure 12).

**Figure 12: 3 year trend of average monthly ACCB and CC billings**

Due to the study timing, - where feedback was provided to physicians at the end of June 2012 with a second extraction occurring at the end of October (i.e. at the end of the tenth month) – the analysis focused on understanding how incentives had historically been utilized in this four-month period. As seen in Table 10 the overall proportion of incentive revenue generated relative to the first six and ten months of the year had been falling since 2009, with an average of \$54,608 being earned by the end of June. In 2012, earnings in the first six months appeared comparable to previous years, suggesting that seasonal earnings patterns were again in effect.

**Table 10: Incentive earnings in select periods, 2009-11**

Year	Earnings at 6 months (Jan-Jun)	Earnings during Intervention Period (Jul-Oct)	Relative earnings: Jul-Oct/Jan-Jun	Earnings at 10 months (Jan-Oct)	Relative earnings: Jul-Oct/Jan-Oct
2009	\$43,115	\$17,955	41.6%	\$61,070	29.4%
2010	\$58,635	\$16,660	28.4%	\$75,025	22.2%
2011	\$62,075	\$12,875	20.7%	\$74,950	17.2%
<b>Average</b>	\$54,608	\$15,830	29.0%	\$70,348	22.5%
2012	\$57,940	--	--	--	--

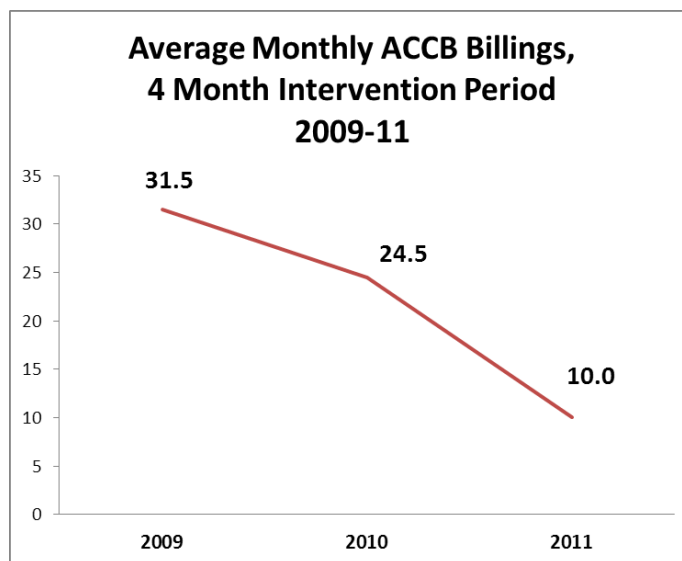
Additional analysis was conducted to determine the average number of incentives billed per month during the four month intervention period for both the ACCB and CC incentive type for the previous three years.

Figure 13 and Figure 14 depict, respectively, how these average rates have been changing over the previous three periods. In 2011, 10 ACCBs and 6.25 CCs were billed on average by the practice in each of the four months of the period.

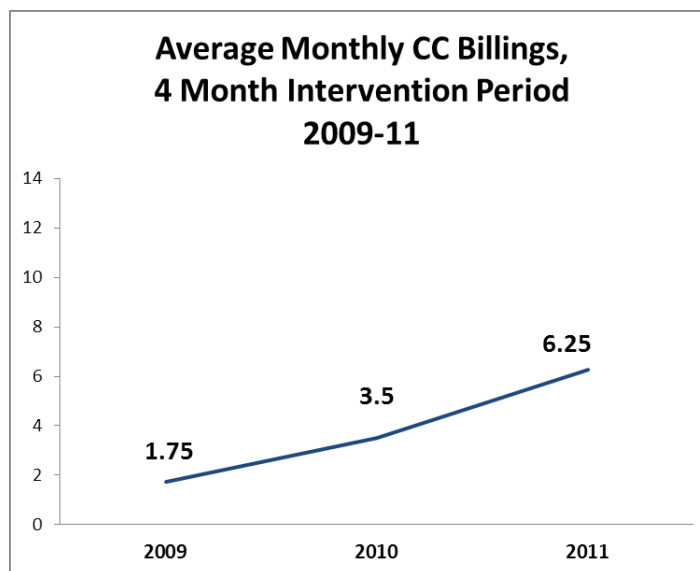
In terms of revenue, the steep declines in use of ACCB incentives combined with modest increases in use of CC incentives had overall resulted in a trend of declining revenue in the period of interest (see Figure 15).

The shift in practice incentive preference had produced a still

**Figure 13: Average number of Annual Care Chronic Bonus billings claimed per month, 2009-11**



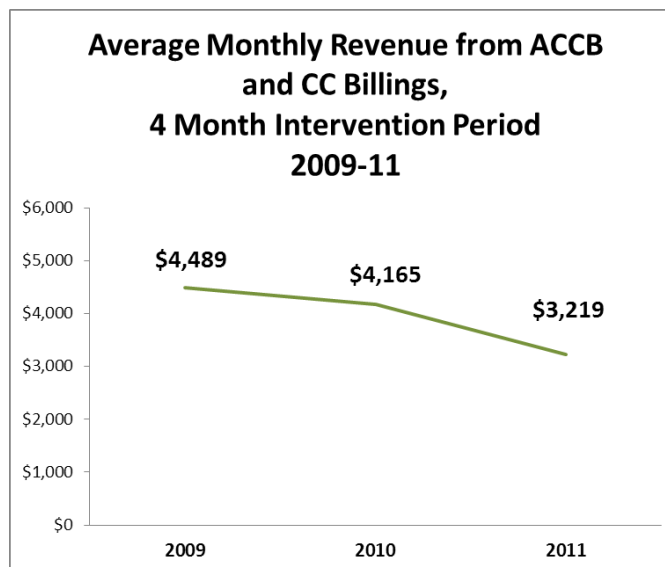
**Figure 14: Average number of Complex Care billings claimed per month, 2009-11**



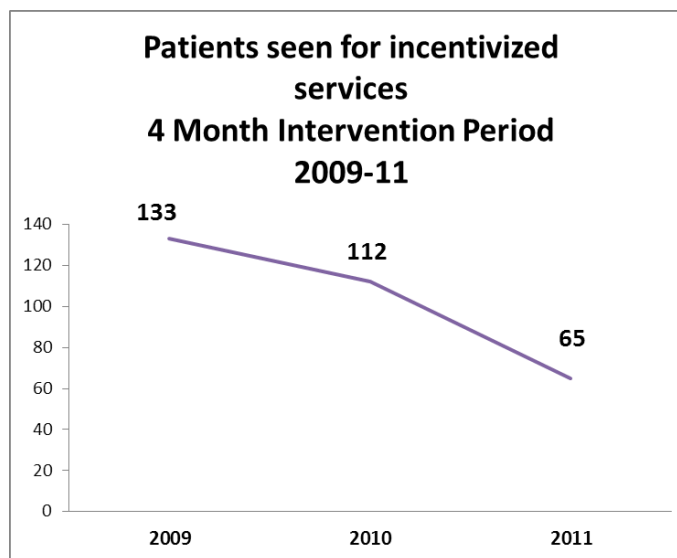
steeper decline in the *number of patients* who are being provided incentivized services (see Figure 16). So, although incentive revenue has declined 28.3% from 2009 levels, the number of patients seen over the same three-year period has declined by 51.2%.

The *four month earnings averages*, the *four month submitted billing claims averages*, the *number of patients seen over the four month period*, together with the *proportion of incentive revenues represented in the four month intervention period* would each be used as baseline comparators for determining whether any change in incentive utilization occurred after the 2012 feedback intervention.

**Figure 15: Average monthly earnings from combined ACCB and CC incentives, 2009-11**



**Figure 16: Patients seen for incentivized services in intervention period, 2009-11**



### 5.2.4 EMR DATA QUALITY

Investigations of four dimensions of EMR data quality were found to be viable after an initial round of exploratory data analysis. Emphasis was placed on quality evaluations of data types implicated

most in the creation and maintenance of reliable diseases registries, namely health conditions. However, other data types were also reviewed in order to inform appraisals of overall EMR adoption. The viable data quality assessment approaches and practice level data quality findings are described here.

#### 5.2.4.1 Consistency of Data Capture

*Consistency of data capture* describes the frequency with which a given data element is recorded within a dataset. To generate reliable disease registries, an EMR must rely on a consistency in the presence of documented of patient health conditions. The natural location for patient conditions in the practice EMR is the Condition List. A practice-level analysis of Condition List data reveals that only 50.3% of patients seen since January 2011 have at least one documented condition entry. This finding corroborates that found from interviews that Condition List functionality is inconsistently used at the practice.

A secondary source of health condition data used to support many parts of the researcher's data analysis was the diagnosis submitted with each physician billing to the Medical Services Plan (MSP). Each billing must include at least *one* diagnosis that will be used by the Ministry of Health to "verify claims and generate statistics about causes of illness and death" (Ministry of Health, 2012b). Without a valid diagnosis, the billing claim will be rejected. Not surprisingly then, an analysis of billing data found that 100% of claims submitted since January 2011 are consistent in that they contain at least one diagnostic entry.

A similar analysis of clinically important, but not CDM-pertinent, allergy data held in EMR Patient Allergy Lists reveals that only 32.7% of patients have at least one allergy entry recorded. This includes entries such as "No Known Allergy" and related abbreviations, e.g., "NKDA", "NA", and "NKA".

#### 5.2.4.2 Consistency of Data Form

*Consistency of data form* describes the frequency with which a given data element is recorded *in a particular format* within a dataset. EMR mechanisms including automated generation of CDM recall

lists, drug/allergy interaction decision support, and CDM billing alerts all require data input that is properly and consistently formatted. The logic of the underlying computational mechanisms is such that they cannot use unstructured free text data in their analytic processes. In the case of patient health conditions, the standard supported by the EMR is The International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) extended with additional pseudo-codes created by the BC Ministry of Health to refer to incentive-related Complex Care disease pairings in billing claims (e.g., H250 indicating presence of both Diabetes *and* Congestive Heart Failure). An analysis of all documented patient conditions from patients seen between January 2011 and May 2012 found that only 25.9% of health condition entries adhere to this standard. This finding correlates well with reports of physicians that they do not tend to code their data as they find the process cumbersome and the available codes of little downstream clinical value. Of the codes that are used, further analysis revealed that 8% come from the “disease-pair” pseudo-codes created by the Ministry of Health intended for use in billings (e.g., H250, R585). Finally, an analysis of free text conditions used in the Condition List reveals that a number of patients have the free text term “Complex Care” as a documented condition. This suggests that some physicians are in the habit of using a locally standardized free text term in conjunction with generic EMR reporting functionality to maintain registries of incentive-eligible patients.

The same consistency analysis performed using billing data found that 100% of diagnosis values submitted with patient billings employed ICD-9. Again, because claims would be rejected by MSP if they did not contain a valid ICD-9 code this finding is not surprising.

Medication prescription data fared slightly better. Here, 36.2% of medication entries contained a Drug Information Number (DIN) indicating that the medications had been selected from the EMR medication repository at the time of prescription generation.

#### 5.2.4.3 Completeness of Data

*Completeness of data* refers to the degree to which a true phenomenon, such as an important fact or event, is recorded within a dataset. To truly determine the degree of completeness (and correctness), it is necessary to have knowledge of how many true occurrences of the phenomenon

of interest actually exist; e.g., how many diabetics are cared for at the practice, rather than how many appear to be present by the data alone. With this knowledge, one can deduce how completely the data item of interest represents the true state of affairs, i.e., the ratio of true positives to all data-indicated positives. Where *consistency of data capture* measures how often a given data element is populated, measures of completeness indicate how often confirmed truths are captured. Rather than being a mere measure of data-type utilization, measures of completeness provide some insight into the greater validity and reliability of a dataset.

To provide some insight into data completeness, the researcher opted to employ a series of *data quality probes*. This strategy, first described by Brown and Warmington (2002, 2003) and later employed by the PRIMIS consultancy in national assessments of UK EMR data quality (2007), employs a series of simple, targeted queries that under conditions of ideal care and data recording should return no results. For example, a query that looks for patients prescribed Spiriva – a medication used solely for COPD treatment – but *not* diagnosed with COPD ought to return zero results. If results are returned, and the record of prescription is perceived as reliable, then it can be concluded that the condition list of the associated patients are incomplete. This method of deducing completeness is limited to scenarios where occurrence of one phenomenon absolutely implies the presence of another. However, its simplicity in application and understandability made it a useful data quality assessment tactic.

Analysis of free text and coded condition list and medication data from January 2011 through May 2012 was used to create patient subsets of “true positives” for conditions diabetes, COPD, hypothyroidism and CHF. Criteria for selection of patients into these subsets was informed by strategies used by BC’s probabilistic registries, as well those described elsewhere in the literature (Brown & Warmington, 2002; Hogan & Wagner, 1997; Ministry of Health, 2012a; Primary Care Information Services, 2007; Wright et al., 2011). For three of the four conditions, the presence of a prescribed medication was deemed to be sufficient to establish disease presence, while in the fourth case multiple instances of a particular billing claim were taken as indication of actual disease. In all likelihood, some false positives were included in, and some false negatives excluded

from, the resulting subset. No attempts were made to verify accuracy of these subsets as clinical audit was not feasible and the relative impact of these false inclusions or exclusions were likely minimal. Similar views have been taken in other research projects confronted with this difficulty in establishing a gold standard reference population (Weiskopf & Weng, 2012; Wright et al., 2011).

Analysis of EMR Condition Lists demonstrated that the data was suboptimal for detecting select chronic conditions (see Table 11). For example, if one was to rely on a combination of free text and coded Condition List data to generate registries for the respective four diseases, those registries would be incomplete in that 12-70% of condition positive patients would be overlooked. Again, this finding is consistent with the report by physicians that use of the Condition List to document patient health conditions is somewhat sporadic. If only ICD-9 *coded* Condition List diagnoses were employed, sensitivity for the reference cohorts would fall further to 4-67%.

A similar analysis of billing diagnoses found the same or somewhat improved data completeness. The sensitivity of billing diagnoses for identifying COPD-positive patients (as again indicated by prescribed medication) remained the same at 70%; while the sensitivity of billing diagnoses for likely diabetics and hypothyroid patients rose to 96% and 59% respectively. Determining sensitivity for the CHF cohort using billing diagnoses was not applicable as the same billing data was used to construct the CHF reference population.

To inform design of queries that would be used to detect disease prevalence, additional analysis examined whether *combinations* of Condition List entries and billing diagnoses improved sensitivity of disease detection. As seen in Table 11, combinations of such data were as, or slightly more, sensitive than Condition List data in identifying the complete set of patients in a given cohort.

**Table 11: Completeness of Condition List, Billing Diagnoses and combinations in detecting diseased patients**

	<b>Disease Subset Reference Standards (Selection Criteria)</b>			
	<b>COPD patients (Spiriva prescribed)</b>	<b>Diabetic patients (Insulin prescribed)</b>	<b>Hypothyroid patients (Synthroid prescribed)</b>	<b>CHF Patients (Two or more CHF- Billings from Jan 2011-May 2012)</b>
<b>Data Quality Probe Inputs</b>	Sensitivity	Sensitivity	Sensitivity	Sensitivity
1. ICD-9 Coded Condition List Diagnoses	40.0%	66.7%	4.0%	28.6%
2. Condition List Diagnoses (incl. free text)	70.0%	87.5%	30.5%	39.3%
3. Billing Diagnoses	70.0%	95.8%	59.2%	n/a
4. Billing Diagnoses OR Coded Condition List Diagnoses	70.0%	95.8%	61.9%	n/a
5. Billing Diagnoses OR Coded AND Free Text Condition List Diagnoses	70.0%	95.8%	75.3%	n/a

#### 5.2.4.4 Concordance of Data

*Concordance of data* describes how well measures derived from certain dataset elements compare to those derived through other means – e.g., figures published in the literature by reputable agencies. Data concordance measures again provide insight into the greater reliability of a dataset.

As previously described, Condition List data was found to be somewhat inconsistent and incomplete. Thus, the researcher was reluctant to rely on Condition List data alone to calculate estimates of disease prevalence and to create the subsets of chronic disease patients necessary to perform other parts of the analysis, such as the extent of incentive utilization. Fortunately, as described above, diagnoses included in billing data submissions were found to be extremely consistent and of higher sensitivity. Therefore, the researcher chose to employ both data elements when creating prevalence estimates and patient disease cohorts. Disease was considered present if a patient record contained a single reference to a disease specific billing or Condition List diagnostic code. This strategy is the same as that used by the EMR reporting mechanism used to detect incentive eligible patients.

Table 12 demonstrates that EMR prevalence rates for diabetes, congestive heart failure and COPD calculated via an analysis of combined billing diagnoses and coded Condition List data do not exhibit excessive *discordance* from published prevalence rates or those determined by the practice level analysis provided by the Ministry of Health's probabilistic registry program. The researcher took this finding as confirmation that the combined use of billing diagnoses and Condition List entries would produce prevalence rates and chronic disease patient subsets of improved accuracy compared to those produced using any single data element. It should be noted that it was not possible to perform an age-sex standardized comparison of the practice population as relevant age and gender data were removed from the anonymized dataset by the EMR vendor before it was given to the researcher.

**Table 12: Disease prevalence rates from different sources**

Disease	Practice Average Prevalence Rate - EMR: 2009-2011	Prevalence Rate - Published literature (Year)	Practice Average Prevalence Rate - Probabilistic Registry: 2010-2011
Diabetes	8.2%	7.4%* (2010)	11.8%
Congestive Heart Failure	1.7%	1.0%^ (2005)	2.7%
COPD	2.4%	4.0%-4.4%** (2004)	3.5%

\* (Canadian Diabetes Association, 2012)

^ (The Canadian Heart Failure Network, 2012)

\*\* (Camp et al., 2008)

### 5.2.5 EMR FEATURE UTILIZATION

Investigations were conducted to determine how often select CDM-oriented EMR features were utilized by the practice physicians. These rates of usage were then used as an additional input for the triangulation of overall EMR adoption.

#### 5.2.5.1 CDM Flowsheet Use

As per the guidance of the GPSC incentive program, billing of the ACCB incentives ought to be preceded by the documentation of certain patient data elements. To support documentation practices, the Ministry of Health and the BC Medical Association authored complementary flowsheet templates. These templates have been included in all PITO conforming EMRs, including the EMR used by the practice under study. While physicians are not bound to use these specific templates and are welcome to create their own, they are expected to document, at minimum, the set of data elements contained in the “official” CDM templates. In the case of hypertension billings, the patient is to be provided a copy of his or her hypertension flowsheet. Moreover, billing of the annual bonuses is only permitted if the given patient was seen for at least two visits in the preceding 12 months. As explained by the GPSC’s Dr. William Cavers in 2010, evidence of these two prior visits ought to be reflected via *two or more* instances of flowsheet documentation (GPSC

*Billing Guide Tutorial*, 2011, sec. 4:37). If a physician is audited for a bonus-linked incentive billing, they will be expected to show that the relevant data was recorded.

During the physician interviews, physicians stated that they did use an EMR with CDM flowsheets, but admitted that use of the flowsheets was somewhat intermittent. An analysis of EMR data reveals that, in fact, flowsheets are used to document care for the majority of patients later billed for ACCB incentives. Of the 257 patients billed for an ACCB service in 2011, 59 patients have no flowsheet, 6 have 1 instance, and 192 have more than 1 instance. That is, approximately 74% of ACCB billings conform to the visit and documentation requirements specified by the GPSC. It should be noted that 52/59 (88%) of the inadequately documented billing claims can be attributed to a single physician. There is no evidence that any of the practice physicians have implemented custom versions of the official CDM flowsheets.

#### 5.2.5.2 CDM Recall Task Use

As derived from the EMR Adoption Survey, the practice physicians, while in the habit of using tasks for various reminders stated that they do not use the functionality as a means to initiate recall of CDM incentive eligible patients. An analysis of task usage verifies this finding. While 14,911 tasks have been generated by the practice staff, zero of these tasks use the “Recall” task template designed for initiating CDM recall. An additional free text analysis of tasks found 186 tasks (less than 1% of the total tasks) that contained a reference to either ‘Complex Care’, ‘Diabetes’, ‘BP’, ‘Hypertension’, ‘COPD’, ‘CHF’ indicating that in very few cases CDM-related recall was being initiated using this mechanism.

#### 5.2.5.3 CDM Recall/Registry Reporting

To support general practices in identification of chronic disease patients qualified for incentives, the EMR featured a reporting tool known as the Complex Care/Chronic Disease Patient (CC/CD) report. This report analyzed both the Condition Lists and billing history of all patients in the practice for the express purpose of identifying those patients with incentive-eligible conditions for whom incentives had not yet been billed. No other tool in the EMR was better suited for generating physician-specific disease registry and recall lists for patients who were incentive-eligible.,

especially in light of the number of qualifying conditions of the CC incentive program. The tool was introduced to the practice's EMR in 2011. Analysis of the audit logs revealed that the tool had been accessed by all of the practice's physicians at least once. It was not possible to determine the extent of interaction, only the date and time that the reporting tool had been accessed by a given user. As illustrated in Table 13, access of the tool was infrequent. This finding corroborates what was reported in the EMR Adoption Survey in that physicians reported EMR recall lists and registry functionality as not typically being used.

**Table 13: Complex Care/Chronic Disease Patient Report Access, 2011-12**

Physician	Accessed in 2011 (# of Times)	Accessed in 2012 (# of Times)
<b>A</b>	Yes (8)	Yes (1)
<b>B</b>	Yes (1)	No
<b>C</b>	Yes (1)	No
<b>D</b>	Yes (8)	No
<b>Practice</b>	<b>Yes (18)</b>	<b>Yes (1)</b>

### *5.2.6 SUMMARY OF EXPLORATORY PRE-INTERVENTION FINDINGS*

According to subjective accounts, the practice physicians had adopted only the basic set of EMR functionality. Use of documentation templates and coded data items was limited. Thus, use of advanced reporting, reminders, alerts, and recall functionality critical for a streamlined CDM practice was minimal, although some physicians expressed a desire to increase use of such tools for that purpose. Analysis of EMR audit data confirmed the subjective reports finding that although CDM documentation templates were used in the majority of cases, the corresponding report and recall functionality were indeed rarely used.

Practice physicians reported that the CDM incentive program was a source of mixed, but still positive appeal; that it brought on some alterations in personal administrative practice; and, that it resulted in attempts to make use of a broader set of EMR features. However, the impact of the CDM

incentive program had yet to produce significant changes in the processes of the practice as a whole or cause physicians to significantly alter their EMR documentation habits as a result of any changing views on data quality and utility. Moreover, usability challenges related to the EMR and ICD-9 further diminished the physicians' pursuit of an EMR-enabled increase in CDM service delivery.

Analysis of EMR billing data collected since 2007 revealed that CDM incentives were under-utilized relative to disease prevalence for all respective conditions confirming subjective reports that there existed opportunities to improve delivery of CDM services. Still, with just 46% of eligible incentives billed, physicians earned an average of \$21,050 each in 2011.

Multiple categories of EMR data including allergies, medications, and condition list entries were found to be of poor quality for uses beyond direct clinical care. Condition list diagnoses, in particular, were found to be inconsistently captured, inconsistently formatted, and incomplete to a degree that the effective use of CDM-related EMR reports and alerts was greatly diminished. However, the practice physicians were not in the habit of using such EMR functionality and thus downstream impact of the poor data quality was not flagged as an issue during interviews. In fact, other documentation habits such as the consistent use of certain free text phrases (i.e., "Complex Care") suggested that some practice physicians have devised certain workarounds to overcome coding challenges.

The preliminary exploratory analysis revealed that the practice did indeed have room for improvement in regards to incentive utilization and EMR adoption. It was also revealed that, in fact, the practice had an interest in making such improvements. Thus, equipped with a series of pre-test measures enabled by the initial exploratory phase of the study, the researcher was able to proceed with the quasi-experimental intervention envisioned in the study design.

### **5.3 INTERVENTION DESCRIPTION**

At the end of June, 2012 the researcher convened a meeting of the four practice physicians and lead medical office administrator to review the results of the EMR data analysis. The meeting lasted 90

minutes and audio was recorded. During this time, the researcher presented a series of slides detailing various pieces of analysis including comparative rates of physician incentive utilization and data quality. Discussion was encouraged and took place throughout the presentation. A significant portion of the presentation focused on illustrating how sub-optimal Condition List data negatively impacted the practice's ability to capitalize on the use of the EMR's primary CDM reporting and registry generation tool – a tool that many of the practice physicians had little knowledge of. Appendix G: Select Intervention Presentation Slides provides a selection of slides used in the presentation.

At the conclusion of the meeting, the researcher posed three challenges to the practice:

1. To increase utilization of CDM incentives by incorporating the use of the EMR's CDM reporting tool, ideally within a pro-active cycle of active recall.
2. To increase the consistency in the use of ICD-9 codes to document CDM related diagnoses on the Condition List.
3. Increase the consistency with which allergies are captured.

The first two challenges related directly to the quasi-experimental hypothesis in that they were designed to test how feedback on incentive utilization and the data quality would impact subsequent elements of EMR adoption and incentive utilization. The third challenge was designed to test only a portion of the hypothesis: how feedback on a *non-incentive linked* aspect of EMR adoption (e.g., data quality of the Allergy List) might affect subsequent EMR adoption as exhibited by any change in data quality.

The researcher made it known that he would return to the practice in approximately four months to repeat the EMR data analysis and report any changes in incentive utilization and data quality. The feedback concluded with a discussion of how physicians might augment their clinical and administrative processes in order to increase EMR driven incentive use.

## 5.4 POST-INTERVENTION ACTIVITIES

In the months following the feedback intervention, the researcher attempted to provide technical and analytic support to assist the practice in making better use of the EMR for the provision of CDM services. Specifically, the researcher:

1. In late June:
  - a. Created a COPD care plan EMR template based on the provincial COPD care plan template that could be used by physicians during visits where the COPD Annual Chronic Care Bonus might be billable. Previously, physicians had cited that the act of creating a care plan as a reason they opted not to bill for the COPD incentive.
  - b. Met with the EMR vendor on the practice's behalf to share some ideas for how the EMR's CDM reporting tool and Condition List documentation might be improved. However, no changes were made to the tool by the EMR vendor within the post-intervention period.
  - c. Augmented the EMR's CDM reporting tool to increase the breadth of eligible conditions and patients that would be detected when the report was executed.
  - d. Volunteered to assist any physicians or practice administrators in learning how to use the EMR CDM reporting tool. However, no physician opted to seek any assistance.
  - e. Attempted to create a "pick-list" of common ICD-9 diagnoses that could be used to shorten the act of Condition List documentation. However, the EMR did not work as expected and this act was unsuccessful even with support from the vendor.
2. In mid-September:
  - a. Provided one physician with a list of potentially "undiagnosed" and incentive-unbilled diabetics derived from analysis of practice data provided by the Ministry of Health. However, the list of diabetics were found to be false positives and thus of little value to the physician.

## 5.5 POST-INTERVENTION FINDINGS

### 5.5.1 CHANGES IN INCENTIVE UTILIZATION

The average monthly incentive revenue earned during the 2012 four-month post-intervention period was 33.5% higher than the combined monthly averages from the same period in the three previous years. As seen in Table 14, although earnings in the first six months of the year were lower than in both 2010 and 2011, by the end of the post-intervention period earnings surpassed any amount earned in any of three previous years.

**Table 14: Incentive earnings in select periods, 2009-2012**

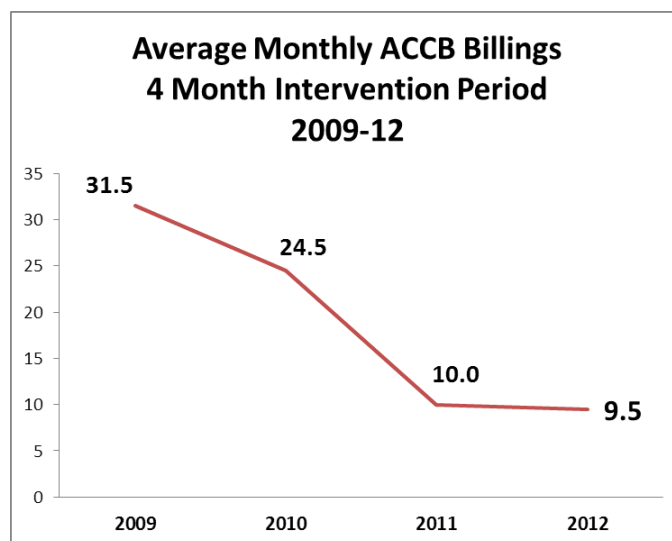
Year	Earnings at 6 months (Jan-Jun)	Earnings during Intervention Period (Jul-Oct)	Relative earnings: Jul-Oct/Jan-Jun	Earnings at 10 months (Jan-Oct)	Relative earnings: Jul-Oct/Jan-Oct
2009	\$43,115	\$17,955	41.6%	\$61,070	29.4%
2010	\$58,635	\$16,660	28.4%	\$75,025	22.2%
2011	\$62,075	\$12,875	20.7%	\$74,950	17.2%
<b>Average</b>	\$54,608	\$15,830	29.0%	\$70,348	22.5%
<b>2012</b>	<b>\$57,940</b>	<b>\$21,130</b>	<b>36.5%</b>	<b>\$79,070</b>	<b>26.7%</b>
<b>% increase relative to 2009-11 average</b>	6.1%	33.5%	7.5%	12.4%	4%

As seen in Figure 17 ACCB incentive utilization continued to decline overall, with 5.0% less of the incentive type being utilized than during the previous year though previously observed year-over-year rates of declines were much larger at -59.2% and -22.2%, respectively. In total 9.5 ACCB billings were submitted in each of the months of the post-intervention period.

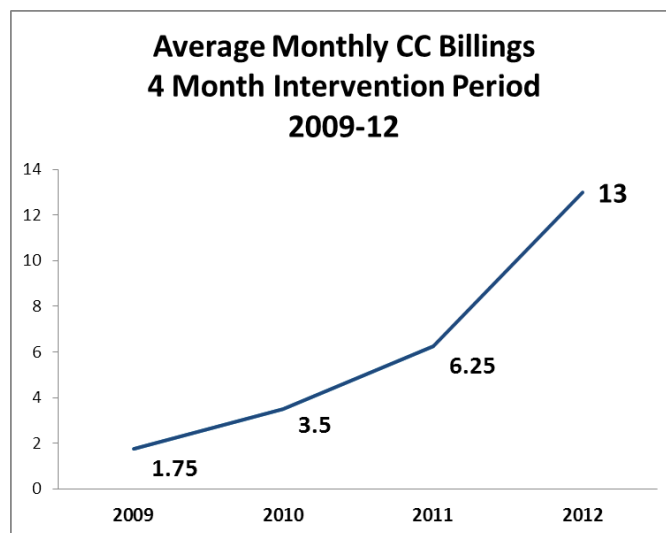
CC incentives also continued the trend established in previous years with a greater number of incentives being billed each month. During the post-intervention period 13.0 billings were submitted by the practice each month, which represents a 108.0% increase over 2011's monthly average. As demonstrated in Figure 18, previous year-over-year utilization rates showed slightly more modest growth with increases of 78.6% and 100.0%, respectively.

With only a small drop in utilization of ACCB incentives, and a larger increase in

**Figure 17: Average number of Annual Care Chronic Bonus billings claimed per month, 2009-12**



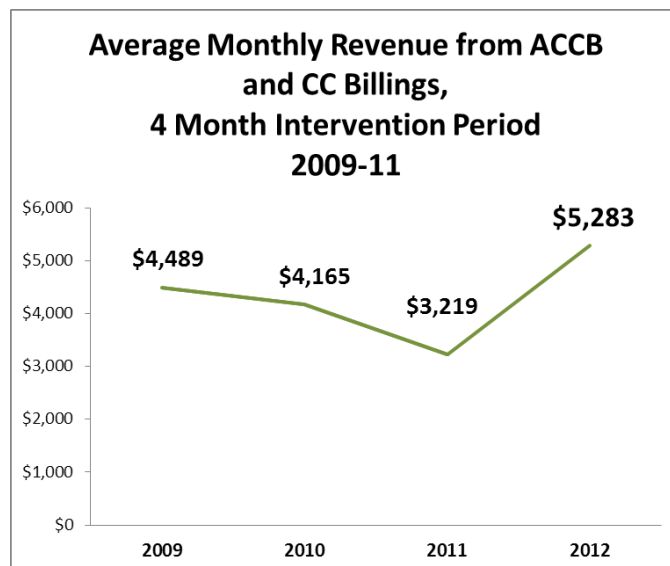
**Figure 18: Average number of Complex Care billings claimed per month, 2009-12**



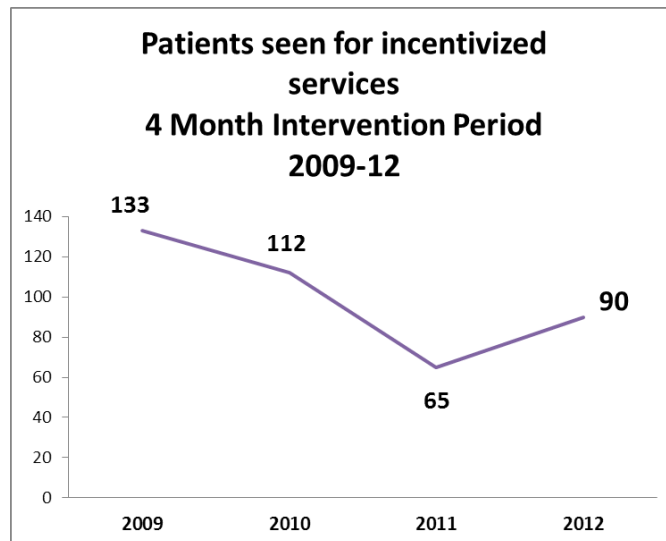
use of CC incentives, the practice's overall average monthly incentive revenue demonstrated a reversal of the trend established in previous years. As seen in Figure 19 average monthly incentive revenue in the post-intervention period grew by 64.1% compared to that earned in 2011, and by 33.5% compared to the combined average of the three preceding periods. This increase follows two period of decline of -22.7% and -7.2%, respectively.

Rather than incentive earnings, an analysis of the *number of patients* who received incentivized services during the four month post-intervention period shows a 38.5% increase from 2011 (see Figure 20). However, the 90 patients seen during the post-intervention period is still 12% lower than the three year average of 103. Again, this is reflective of the practice's move away from provision of lower yielding ACCB incentives towards fewer, but more lucrative, CC incentives.

**Figure 19: Average monthly earnings from combined ACCB and CC incentives, 2009-12**



**Figure 20: Number of patients provided incentivized services, 2009-12**



Still, by the end of the four month intervention period, 324 patients had been provided an incentivized service *at some point* in 2012. This represents a 6.9% increase over the average number of patients seen for incentivized services in the same period over the preceding three years (324:300).

## 5.5.2 CHANGES IN EMR FEATURE UTILIZATION

### 5.5.2.1 CDM Flowsheet Use

In the post-intervention period, 47 patients were billed for an ACCB service. Of those, 13 had no corresponding flowsheet, while 34 had two or more instances. That is, in the post-intervention period, 3.2% *fewer* of the ACCB billed patients had the appropriate level of documentation. Again, one physician was responsible for the majority (12/13, 92%) of the seemingly inadequately documented billings.

### 5.5.2.2 CDM Recall Task Use

There were no changes detected in creation of tasks related to CDM activities. Of the 2,744 tasks created in the post-intervention period, less than 10 made any mention of terms related to provision of CDM services.

### 5.5.2.3 CDM Registry/Recall Reporting

The EMR's Complex Care/Chronic Disease patient report was accessed nine times in the post-intervention period, with each physician opting to run the report twice or more. This represents an increase of 800% compared the pre-intervention period of 2012. This report was discussed at length during the feedback presentation and suggested to be the most suitable tool in the EMR to support active CDM recall. Report access peaked in the few days after the feedback session, with six of nine recorded accesses occurring within four days of the presentation. However, only three more accesses were observed after this period suggesting that the tool was not incorporated into a regular (e.g., monthly) CDM recall process. Table 15 summarizes report accesses.

**Table 15: Complex Care/Chronic Disease patient report access summary**

<b>Physician</b>	<b>Accessed in 2012, Pre-Intervention (# of Times)</b>	<b>Accessed in 2012, Post-Intervention (# of Times - Month)</b>
<b>A</b>	Yes (1)	Yes (3 - June/Aug)
<b>B</b>	No	Yes (2 - June)
<b>C</b>	No	Yes (2 - June/July)
<b>D</b>	No	Yes (2 - June)
<b>Practice</b>	<b>Yes (1)</b>	<b>Yes (9 - Jun/Jul/Aug)</b>

### 5.5.3 CHANGES IN EMR DATA QUALITY

#### 5.5.3.1 Consistency of Data Capture

The relative proportion of patients with a recorded condition grew post-intervention by 7.2%. The proportion of patients with a recorded allergy entry increased over the same period by 41.3%.

#### 5.5.3.2 Consistency of Data Form

The overall proportion of conditions recorded using ICD-9 declined by 3.9% following the intervention. While the proportion of *patients* with an ICD-9 recorded condition stayed the same - meaning that a greater number of patient conditions were documented using ICD-9 than in the pre-intervention period - the increase in use of ICD-9 did not outpace the use of free text.

Similarly, the proportion of prescribed medications fully coded with DINs declined by 3.6%.

#### 5.5.3.3 Completeness

The completeness of ICD-9 coded condition lists improved for all four conditions tested. The sensitivity of ICD-9 coded diagnoses for detecting Diabetes, COPD and Hypothyroidism and CHF improved by 4.9%, 4.2%, 192.5% and 2.8% respectively. This indicated that for these conditions the practice physicians were taking steps to document the condition employing ICD-9.

Table 16 provides a summary of all pre- and post-intervention data quality measurements.

**Table 16: Data quality findings**

<b>Data Quality Measurement</b>	<b>Baseline Measure</b>	<b>Post-Intervention Measure</b>	<b>Absolute Percentage Point Difference</b>	<b>Relative Percent Change</b>
Consistency of Capture – Condition List	50.3%	53.9%	3.6%	7.2%
Consistency of Capture – Allergy List	32.7%	46.2%	13.5%	41.3%
Consistency of Form – Condition List	25.9%	24.9%	-1.0%	-3.9%
Consistency of Form - Medications	36.2%	34.9%	-1.3%	-3.6%
Completeness – Diabetes Coding	66.7%	70.0%	3.3%	4.9%
Completeness – COPD Coding	40.0%	41.7%	1.7%	4.2%
Completeness – CHF Coding	28.6%	29.4%	0.8%	2.8%
Completeness – Hypothyroid Coding	4.0%	11.7%	7.7%	192.5%

#### 5.5.4 SUMMARY OF POST-INTERVENTION CHANGES

Recall that three improvement challenges were proposed to the practice during the feedback intervention. These were to:

1. Increase utilization of CDM incentives by incorporating the use of the EMR's CDM reporting tool in a regular cycle of active recall.
2. Increase the consistency in the use of ICD-9 codes to document CDM related diagnoses on the Condition List.
3. Increase the consistency with which allergies are captured.

A portion of the objective laid out in Challenge #1 was met. Incentive utilization, as indicated by earnings, increased by 64.1% year-over-year and by 33.5% compared to the preceding three year average. However, while 38.5% more patients were seen in 2012 compared to 2011, there was no improvement observed over the three year average. Furthermore, there was no evidence that the practice instituted an active recall program at the practice – use of relevant EMR features was

minimal and ACCB incentive earnings continued to decline, albeit at a slower pace than in previous years.

Challenge #2 objectives were met. Although overall proportion in use of ICD-9 fell, it rose slightly for select CDM conditions as detected through improvements in the sensitivity of the Condition List.

The final objective - to raise the capture rate for allergies documented in the Allergy List - featured the largest improvement. Thus, successes were achieved in each of the three proposed challenge areas.

#### *5.5.5 POST-INTERVENTION FOCUS GROUP DISCUSSION*

In December, 2012 the researcher returned to the practice to deliver results from the post-intervention EMR data analysis. Changes in incentive utilization, EMR data quality and EMR feature utilization were presented. In addition, the physicians were provided with a list of patients with seemingly outstanding CC billings. At the end of the feedback session, a series of questions (see Appendix C: Post-Intervention Focus Group Discussion Questions) were posed to the four physicians in attendance that addressed three major themes: whether the intervention feedback provided was perceived as useful; whether the feedback provided was motivating; and why any subsequent changes were or were not made.

All physicians reported that the feedback was useful to them, with some stating that it was “very” or “extremely” useful. In particular, the physicians expressed a good deal of gratitude in being supplied with feedback around their own and the practice’s level of incentive utilization. Feedback around other aspects of data quality, e.g., allergy lists or use of ICD-9, was regarded as “nice to have”, but did not spur on nearly as much discussion or prompt as many questions as did the incentive utilization feedback. When the offer was made to provide researchers with list of candidate patients with outstanding billings, all physicians expressed interest in seeing their respective lists.

*“I’d like to see the report... Sure I’d like to look at mine too if you could do up the list.... I look forward to seeing that report”*

While all practice physicians indicated that the feedback information was useful, not all stated it was motivating in prompting changes in both documentation practice or incentive utilization. One physician simply stated that he forgot about the EMR report amidst his other duties and therefore did not make attempts to incorporate it into practice.

*"I just forget about it. There is other stuff to do"*

However, the majority of physicians reported that as a result of the feedback intervention they did take steps to make changes in practice. Examples of reported actions that were taken that demonstrate evidence of motivation include: a request was submitted to the EMR vendor for usability improvements in the Allergy List that would make it easier to document that a patient had "no known allergies"; administrative staff were asked to scan the paper face sheets into the EMR in order to support the physicians in adding allergies and conditions to the EMR in advance of referral creation; and, most physicians did in fact run the EMR's CDM report in order to cross reference the patients against their manual list of outstanding billings, which itself prompted updates to patient information when it was discovered that deceased patients were appearing on the report.

When asked to provide reasons why changes in either documentation practice or incentive utilization occurred, the following change enablers were reported. Firstly, physicians stated that knowing about the EMR's CDM report and knowing how to interpret it made it easier to fine tune their own, manually maintained, list of potential CDM billings. Secondly, physicians reported that by having updated allergy and condition list information the process of creating referrals became easier – that is, the process of updating patient data was perceived as having enough downstream benefit to warrant the effort of adding the additional documentation.

*"I'm spending more time on referrals, but I'm getting the stuff in there for next time. It's tedious and I feel bitter about it, but it's in there, and I won't have to do it again."*

Physicians also cited that the ability to rely on administrative staff to scan in and, in some cases, enter allergy information into the EMR as helpful in making change. Finally, two physicians said that deciding to be being upfront with patients about the incentive program - by sharing with them

the reason the program exists and the fact that the physician was being paid an extra amount of money to provide the service - made them feel better about billing the incentive.

*"I just tell the patient that government pays me to look over your chart to make sure you don't get sicker ... it helps, taking the time does help the patient."*

When physicians were asked to provide reasons why the level of change in incentive use and documentation were not greater, many detractors were identified. The dominant detractor mentioned was *lack of time* to dedicate to a) running and verifying the results of the EMR CDM report, b) coordination of new processes in the clinic and, c) providing CDM services in light of all the other patients that need to be seen.

*"There is just not enough hours in the day.... Need time to implement all that stuff. "*

*"Some patients should not be billed, but the report won't let me exclude patients. So every time I run it, I have to re-think about who needs to be excluded. Takes time. Adds hours to your process."*

*"I know it's more money, but I just want more sleep."*

*"I don't have the appointments for that [CDM appointments]... as it is I'm booked for the next month."*

The second strongest detractor cited was the design of the incentive program itself. First, all physicians again raised the issue of possible audit by the government and the risk of having revenue clawed back if it was found that the documentation requirements (themselves perceived as unrealistic to satisfy) were not met.

*"So few people are audited, but if they were the whole thing would change/go away. I don't think there is a doctor in the province that could do it totally legally because you're supposed to set a half an hour plus the time for an office visit. When they made this, they obviously knew no one was going to do this – all we've done is made ourselves vulnerable [to audit]."*

*“The COPD and HT ones are a pain in the ass. It’s such a bloody pain (documenting all the template required info)... The COPD incentive says you need PFTs (pulmonary function tests) documented and that takes like 5 months to get...”*

Others expressed that they did not feel the guidelines provided in the incentive program were correct and thus, did not want to feel obligated to provide the “recommended” care implicated by the billing of an incentive.

*“I don’t want to follow the advice of the [COPD] guideline – if you cough, I don’t want them just to take the antibiotic – I want to see the person... So I tell them to come in if they feel bad which isn’t following the guideline.”*

One physician just stated that billing the incentives felt “sordid” and thus was not inclined to devote a lot of effort to increasing incentive billings. Others felt that the gaps in incentive use reported during the feedback session were somewhat exaggerated, and thus were less inclined to make changes in their billing behavior.

Problems were also raised that were associated with extending the duties of administrative staff. Physicians were hesitant to add workload to a staff perceived to already be under a good deal of stress. Moreover, physicians were hesitant to allow administrative staff to make judgments about what patients should qualify for a billing service, or even record allergies.

*“Even for allergies, I want to hear from the patient, I don’t want someone else to put that in for me. I want to be sure it’s been recorded correctly.”*

In regards to increasing use of ICD-9 in condition list entries, all physicians reported that the coding system and coding interface was inadequate for their primary clinical needs.

*“I don’t like putting codes in – I like putting information in... I’m the same – “Hypothyroidism Acquired” just doesn’t tell me anything...”*

*"I can't have that stuff in my referral letter. You need to be able to code and then alter the description."*

Finally, problems with the EMR's CDM report were raised. In particular, the report did not permit for the exclusion of patients that, although they technically met eligibility criteria, were in fact not suitable or would otherwise not benefit from receiving the incentive-implicated care. As a result, each time the report was run, physicians had to dedicate time to sifting through the results. Generally, the physicians stated that the usability of the report could be improved.

## 6 DISCUSSION

This research set out to address two primary research questions:

- 1) How does the presence of CDM incentives affect EMR adoption in a BC family practice, and conversely how does the extent of EMR adoption impact the delivery of incentivized CDM care?
- 2) Does a program of EMR data analysis, feedback and provision of EMR support positively impact subsequent EMR adoption and delivery of incentivized CDM care by a BC family practice?

In addition to answering these questions, it was the hope of the researcher that some additional insight could be provided that would help to hone the tools of a researcher involved in EMR-based primary care research. Of special relevance to this project are tools such as the Clinical Adoption Framework; the EMR Adoption Framework (particularly the EMR Adoption Survey); methods to assess EMR data quality; and, a UK-inspired program for fostering improvements in EMR data quality via audit and feedback.

In the discussion sections that follow, the reader will first be presented with a summation of the techniques, findings and implications related to incentive utilization and the ascertainment of EMR adoption levels. After a brief discussion of possible enhancements to the various tools used to derive and interpret these findings, the relationship between EMR adoption and incentive use will be explored from the vantage point of the CAF. Next, the discussion will shift to interpreting the results of the audit and feedback intervention. Finally, the discussion will conclude with a reflection on the potential implications of this research in the context of provincial CDM objectives, the EMR agenda, the incentive program and emerging forces in BC general practice.

### **6.1 INCENTIVE UTILIZATION AT THE PRACTICE**

Analysis of incentive utilization using billing data stored within the EMR proved to be a useful method of deducing how completely the practice was billing for incentivized services. Because

billing data is a) core to the financial viability of a practice and b) mandated to include well defined coded data that describes both the service provided and at least one medical condition associated with that service, the researcher found that the administrative dataset was not only of high utility in deriving utilization of incentives, but also in contributing to estimations of disease prevalence necessary to determine the extent of incentive utilization. In combination with Condition List data, the billing diagnoses enhanced the sensitivity of disease case finding algorithms. The usefulness of the data in this regard was curtailed due to the fact that diagnostic codes selected for inclusion in billing claims can be quite non-specific (e.g. 780 – General Symptoms). Moreover, the requirement for just a *single* diagnostic code per billing means that it is unlikely that a single billing claim will permit for the discovery of a patient or single encounter where multiple co-morbidities were addressed. These shortcomings associated are well understood in the Canadian context (Terry et al., 2010).

The billing data analysis for this clinic illustrated that relative to disease prevalence estimates, incentivized services are under-utilized. A second finding demonstrated that rates of under-utilization have grown each year for the lower yielding Annual Chronic Care Bonuses (ACCBs), with the number of higher yielding Complex Care (CC) services increasing over the same period. Overall, this data suggests that *fewer* patients are being provided incentivized services each year - unless, of course, the services are in fact being provided without being billed.

For physicians, this decline in billed service provision has had only minimal impact to overall earnings due to the fact that CC incentives yield almost three times the amount of the ACCB incentive type. However, from the standpoint of a health system planner, this move away from the ACCB incentive in favor of the CC incentive is less desirable. As discussed in a 2010 evaluation, the CC incentives in and of themselves actually *increase* overall health system costs (Hollander & Tessaro, 2010). It is the provision of ACCB-implicated services that are responsible for the majority of the cost-savings attributed to the wider GPSC incentive program. Thus, a move away from ACCBs in favor of CCs may in fact be having an adverse effect on overall health system cost efficiency. If the billing habits of this practice are reflective of a wider trend in general practice, then there may

be reason for concern. However, the long term impact of the CC incentives in BC have not yet been studied, so it is difficult to forecast what effect the pattern of use observed at the study practice might have if in fact it did represent billing behaviors in a larger number of practices.

## **6.2 UNDERSTANDING EMR ADOPTION USING MULTIPLE INSTRUMENTS**

Following the mixed methods design, a combination of qualitative and quantitative instruments was used to collect and mix data related to EMR adoption, in particular aspects of adoption tied to the practice of CDM. A review of each of the key instruments and discussion of the findings they produced are provided in the following sections.

### *6.2.1 THE EMR ADOPTION SURVEY*

The EMR Adoption Survey proved to be extremely valuable in fostering conversations about a wide array of EMR functionality with the various practice physicians. In addition to producing physician-level scores to subjectively reflect degrees of EMR adoption, many conversations were initiated that gave the researcher a richer understanding of how the EMR fits into daily clinical practice.

Moreover, its coverage of CDM-related EMR functionality was sufficient in that questions existed to address disease registries, recall functionality, clinical documentation, and decision support. Thus, the researcher was able to glean insight into how the practice of providing CDM care was affected by the EMR.

The practice's overall adoption score was 2.3/5. Without published benchmarks from similar practices and in light of the fact that a 5/5 score is impossible to achieve in the given BC primary care informatics context (i.e. one that lacks various interoperable mechanisms to facilitate inter-organizational data exchange), this score is somewhat difficult to interpret. A recent, but currently unpublished study conducted at four family practices in Manitoba found adoption scores ranging from 2.3-3.0 (M Price, Singer, Kim, & Partridge, 2012). Compared to these practices, this study's family practice achieved similar scores across most adoption categories. With, adoption scores of 3.1, 3.0 and 1.8 in the respective and especially CDM-pertinent categories of "Health Information", "Reporting and Population Health Management" and "Decision Support" indicated that the practice

was struggling to move beyond the paradigm of an “electronic paper record” and take full advantage of advanced registry and reporting features of the EMR so as to provide comprehensive CDM services. Still the score of 3.0 in the “Reporting and Population Health Management” was higher than all four of the Manitoba practices which is reflective of the practice’s recent, but still relatively unsophisticated attempts to make use of the EMR’s reporting functionality.

In addition to establishing benchmarks that can be used to situate EMR adopters against peers, the researcher felt two other modifications might improve the usefulness of the EMR Adoption Survey. First, interpreted strictly as written, portions of the EMR Adoption Survey award points for the mere fact that users use an EMR *capable* of performing certain functionality, rather than on the basis of whether or not the functionality is used. For example, question #20 awards four out of five points if the physician agrees with the statement, “I use an EMR that has flow sheets and I then can generate reminders and recall lists.” While a researcher may recognize the spirit of the question and interpret its intent is to award points to those *who actually use flowsheets* and related functionality, there is no guarantee that this nuance will be recognized by each researcher using the tool. Similarly, the language of the survey is such that it awards higher scores without attempting to deduce how often or how regularly those high-scoring actions are performed. Thus, practices with only minor experience using EMR features might earn similar scores to those practices who routinely incorporate those features into practice. Minor enhancements to the language employed by the survey would likely increase the comparability and utility of scores produced by different survey users.

### 6.2.2 EMR FEATURE UTILIZATION

Analysis of EMR audit log data was quite simple to perform. Fortunately, the audit logs produced by the EMR maintained data on use of CDM-oriented EMR functionality including template, task, and chronic disease reporting. In the absence of EMR conformance specifications that mandate what portions of the EMR must be auditable there is no guarantee that other researchers conducting research using other EMRs, or with other research interests, would be as fortunate.

Results of the feature utilization provided a useful, objective and complementary view into the level of EMR adoption at the practice – particularly in regards to adoption of CDM-pertinent features.

During interviews, physicians suggested that while some attempts had been made to use pertinent EMR functionality they could make further improvements to support CDM service provision.

Analysis of audit logs demonstrated that for the most part, EMR functionality used to support active management of CDM populations was rarely, if ever used. That is, none of the registry, recall or reporting tools associated with a successful CCM-based CDM program were in use at the practice.

Although the EMR was implemented almost five years ago, practice physicians were still opting to craft and maintain lists of CDM eligible patients using manual techniques and opting to provide incentivized care on an opportunistic rather than active basis. Without the perspective provided by analysing the audit logs, it would have been difficult to arrive at such a definitive conclusion.

### *6.2.3 EMR DATA QUALITY*

Analysis of EMR data quality required extensive EMR data exploration before the researcher was able to determine what facets of quality could be interpreted and what methods of analysis would yield useful outputs.

Being that CDM practices were of core interest to the researcher, much of the data quality analysis focused on data elements that are relied upon when users of the EMR attempt to generate reliable disease registries. For the EMR under study, construction of disease registries depended on how well patient conditions were documented in billing claims and within the EMR's 'Condition List'.

Understanding that billings claims would have a relatively high degree of consistency, the bulk of effort was placed on measuring quality of condition list data alone, as well as the utility of combination of billing and condition list data in identifying disease subsets. Condition list and billing data was assessed for quality in four dimensions: consistency of capture, consistency of form, completeness and concordance. To inform assessments of EMR adoption in aspects of care not directly linked to provision of CDM services, additional assessments of the consistency of medication form and allergy data capture were performed.

In all categories, data quality was found to be of poor quality for supporting uses beyond direct clinical care (i.e. reading the chart). These shortcomings in data quality further supported the notion that the EMR has not been fully adopted by the practice because, with data of such quality, it would not be possible to reliably use “advanced” EMR features including medication decision support, automated reminders based on documented conditions, or reports to generate accurate recall lists. In response to usability shortcomings of the EMR’s documentation mechanisms and a particular inadequacy on the part of the ICD-9-CM classification to adequately represent the necessary range of clinical concepts, the practice physicians opted to employ individualized data collection strategies that address only immediate and short-term priorities. For instance, documenting patients using Condition List entries such as “complex care”, while useful for keeping track of patients who qualify for the incentive program *as is*, may quickly become cumbersome if and when the criteria for incentive eligibility change. Already, analysis of the Condition List revealed instances where now obsolete specialty billing codes continue to be used to document patient health conditions. Without the establishment of a clinician-valued business case to increase the breadth and secondary utility of collected data, there is little reason to believe the state of data quality will change.

Unfortunately, the data quality findings at this BC family practice do not deviate from the more general reports of poor data quality encountered by other Canadian EMR primary care researchers and health system planners (Birtwhistle et al., 2009; Sullivan-Taylor, Mukhi, Martin-Rhee, & Webster, 2011; Terry et al., 2010, 2011). The data quality shortcomings that detract from the practice’s ability to use advanced EMR functionality would also detract from the utility of data for non-clinical, secondary purposes including research and public health surveillance.

Future applications of EMR data quality assessments could be enhanced by the incorporation of more advanced and better validated case detection algorithms. These algorithms, such as those created by Wright et al. (2011) would support an analyst in assembling a greater variety of disease cohort reference standards to use as the denominator in calculations of data completeness and correctness. By extending case detection inputs from billing and condition diagnostic codes to

include medications, lab results, referrals, etc., a researcher may be able to provide a greater estimation of overall EMR data quality. Still, this research demonstrates that even *estimates* of disease prevalence and incentive utilization that are considered to be reliable may still provide value in encouraging change. Thus, an inability to provide absolute measures should not be seen as a detractor from providing useful, motivating feedback.

Other dimensions of quality such as currency and comprehensiveness might provide additional insight into a dataset's utility for advanced clinical and secondary uses. Ultimately though, the choice of data quality metrics should reflect the intended use(s) for the data under study. To that end, the process used in this research to ensure that data quality assessments remained true to the context of use, may be helpful. This process - outlined by Bowen and Lau (2012) - was featured in Table 5.

#### 6.2.4 TRIANGULATING ADOPTION

Overall, the addition of data quality and feature utilization assessment tools did not change the researcher's view on the practice's *overall* level of EMR adoption as was derived from use of the EMR Adoption Survey alone. However, the use of these additional techniques provided the researcher with a much richer understanding of specific adoption gaps - particularly those that related to provision of CDM services. Without those additional tests, the researcher would have been less confident in his interpretation of the EMR Adoption Survey score and would have been less equipped to design a feedback intervention to encourage greater adoption.

Had the researcher not been provided with an anonymized extract of the EMR data, it would have been extremely difficult to produce the quantitative accounts of EMR data quality and feature utilization, as well as estimates of prevalence and incentive utilization. Without the extract, the researcher would have either had to a) entice the EMR vendor to design and perform the queries necessary for analysis, or b) coordinate time to work on a practice's computer in order to use the EMR's native reporting interface as a means to try and perform the analysis. In reality, neither of those options would likely have proven feasible - the EMR vendor would likely not have had the resources to dedicate to uncompensated academic research activities, nor would the practice have

been able to accommodate the researcher with the many hours of supervised access to a practice workstation, nor would the EMR's native reporting interface provide the transparency or functionality that would permit for the construction and verification of the products of analysis. These difficulties of accessing EMR data have been cited as major obstacles to using EMR data in research and thus need to be taken into account when considering applying the methods used in this study to new projects (Terry et al., 2010).

After five years of using the EMR, the practice's overall level of adoption was such that it was in effect an "electronic paper record" (M Price et al., 2012). While certain benefits such as increased legibility, increased data accessibility, and increased productivity due to features such as referral generation were no doubt achieved, other benefits, which can only come with use of advanced EMR features preceded by high quality data collection, had not been realized. While organizations like PITO and Canada Health Infoway publicize many case studies and examples of efficiencies gained by select EMR adopters who have incorporated advanced EMR features into practice, this study illustrates that adoption of advanced EMR functionality is not an inevitable by-product of implementation (Canada Health Infoway, 2012; Physician Information Technology Office, 2012a, 2012b). In some cases, and as described in previously discussed research including that related to the CCM, additional forms of support and intervention may be necessary (Lau et al., 2012; Nutting et al., 2009).

### **6.3 FROM THE MACRO TO THE MICRO: THE RELATIONSHIP BETWEEN EMR ADOPTION AND INCENTIVE USE**

According to the CAF, successful EMR adoption is a product of many interacting forces. To understand how these forces coalesce to influence adoption, a line of questioning inspired by Silver et al.'s "Reactive Analysis of an Information System", Kotter's Organizational Change Model and the constructs of the CAF proved useful. The resulting set of questions provided some insight into *if* and *how* a given set of CAF forces encouraged adoption of a select set of system functionality – in this case how existence of standards and incentives encouraged use of the EMR to support provision of CDM services. This ability to partially trace the path of influence from the macro to the

micro level proved helpful in understanding whether the adoption, or non-adoption, of certain EMR functionality was indeed affected by higher level forces.

In this case, the macro-level incentive program appeared to exert mixed, but still sufficient, influence to encourage the majority of physicians to find ways to provide incentivized CDM services and to manifest a new demand for the EMR system to support them in this regard. That is, incentive availability did have a positive effect in encouraging EMR adoption. This pro-adoption effect of incentives was recently noted in Lau et. al's CAF-informed systematic review of factors affecting EMR success (Lau et al., 2012). However, a micro-level failure of the system to make the relevant functionality known to the users; to instil in its users principles of data stewardship to optimize such use; and, to offer the desired functionality with a high degree of usability – each of these detracted from the likelihood of practice physicians adopting the EMR for enhancing the provision of CDM services. Moreover, the failure to adopt was exacerbated by a lack of influence emanating from the macro-level domain of healthcare standards. There was little evidence to suggest that the meso-level users were knowledgeable of the ICD-9 classification system, nor its potential value in enabling creation of disease registries. The failure of the standard to be understood or perceived as useful suggests a failure in either the inherent value of the standard or the manner in which it has been communicated. It may also indicate a System Quality failure in that the usability of the EMR interface was reported to insufficiently support effective coding practices.

In conducting the interviews and in later observations of EMR use, the researcher came to feel that failures emanating from the micro-level domain of Service Quality contributed significantly to the lack of widespread adoption of the EMR for provision of CDM services. Had greater education been provided to make more relevant CDM functionality known to the users and to illustrate the relationship between data quality and efficient use of said functionality, the physicians may have been more prone to develop competency in their use. At the same time, the researcher was left with the impression that the physicians had not dedicated ample time to considering how best to augment macro-level organizational processes or seek micro-level assistance in developing greater EMR competency for the purposes of pursuing greater provision of CDM services. This may have

been due to the perception reported by the physicians that they felt they were doing a satisfactory job of providing CDM services irrespective of the CDM incentive program itself. However, in light of the physician comments provided during the post-intervention feedback discussion, it appears that the demands of regular practice characterized by the “tyranny of the urgent” truly left the physicians with little time to reflect on, organize and monitor change efforts.

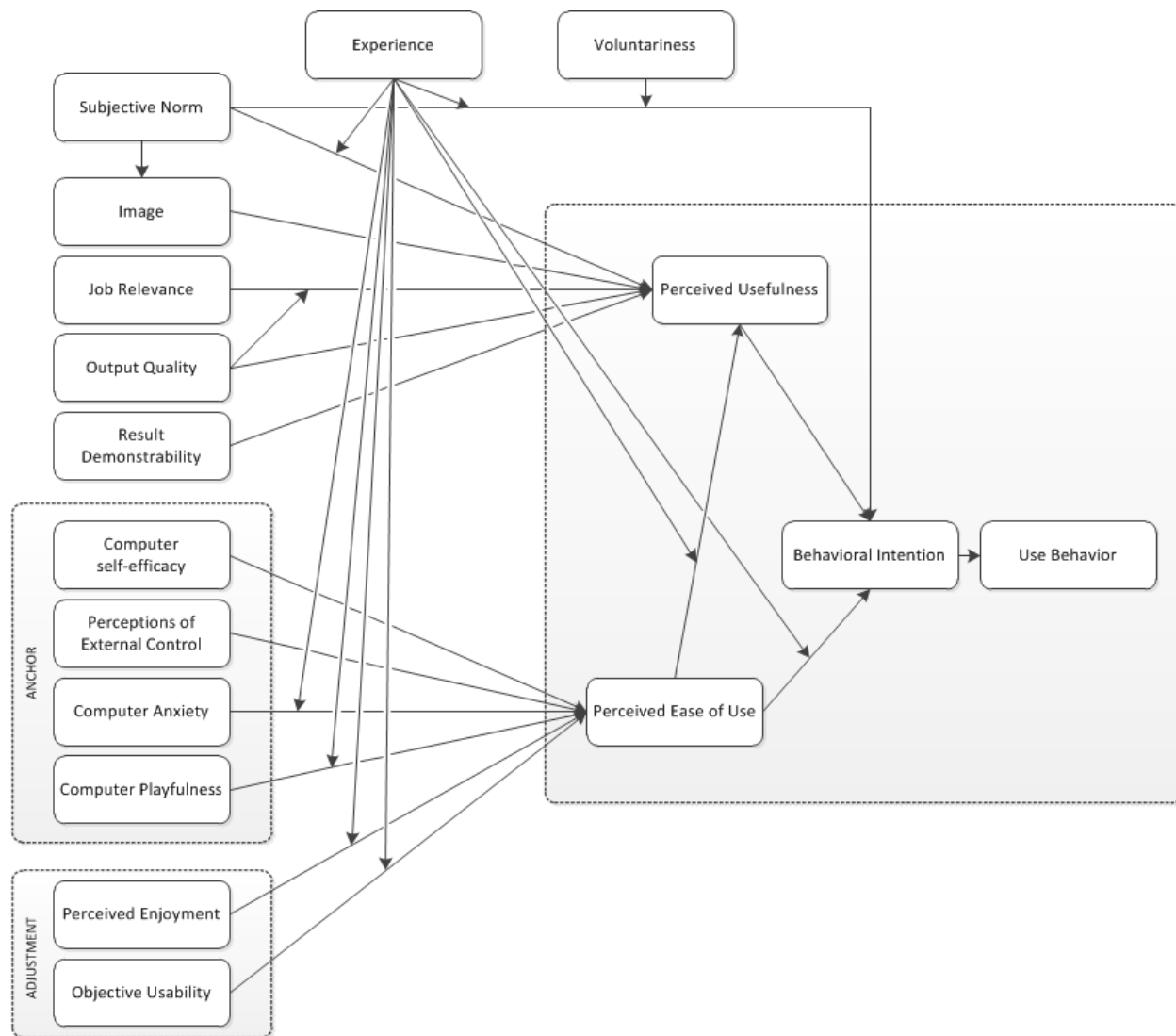
Although the macro-level incentive program did succeed in encouraging some meso- and micro-level change, these were not yet fully realized. Furthermore, the under-utilization of incentives could not be fully attributed to deficiencies in EMR adoption. In the language of the CAF, micro-level failures in Service and System Quality (which resulted in failures of Information Quality) obstructed *to a degree* the execution of intended System Uses (e.g., the regular identification of incentive eligible patients), thus compromising the achievement of Net Productivity, Quality or Access Benefits (e.g., improved utilization of incentives). However, the macro-level incentive program and the ICD-9 healthcare standard were not perceived to be entirely positive at the meso-level. Thus, their capacity to induce positive change in the downstream domains of People, Organization and Implementation was diminished. Finally, the reality of the meso-level experience, with its limited time and lack of resources with which to implement change, resulted in a further reduction in the ability to respond to available incentives, including the development and refined execution of additional System Uses.

In summary, the incentive program *did* produce a desire in the practice to adopt the EMR to a greater degree. However, for a variety of reasons – including, but not limited to deficiencies of the EMR – the expansion of adoption to include use of features relevant to the optimized use of incentives was curtailed. Thus, the EMR had yet to significantly enhance the practice’s ability to make better use of available incentives. These findings are not incompatible with the recent, CAF-guided observations of Lau et. al (2012) who point out that presence of incentive programs do correlate with successful EMR implementations, but that a wide variety of other factors also play a role in shaping and encouraging adoption.

### 6.3.1 ENHANCING EVALUATIONS USING THE CAF

The CAF and its suggested evaluation mechanisms were very useful in developing a line of questioning that accounted for the breadth of factors that may influence system adoption. The researcher feels that future CAF inspired evaluations would be strengthened with the development of, or suggestion to use, other tools designed to expose and better trace the “direct effects” among inter-level CAF entities. Without evidence that entities exert influence and without a good understanding of how this is accomplished, it is difficult to distinguish with certainty whether certain characteristics of CAF entities *contribute to* system success or non-success, or whether they are merely *correlated* with it. As described by Lau et al.’s 2011 publication, the CAF might be perceived as most useful in *cataloging* the context of an information system (Lau et al., 2011). The table of dimensions, categories and suggested measures described in the article’s main table (Lau et al., 2011, p. 42) would enable an evaluator to describe in detail each of the major entities that comprise the wider context of an implemented, or to-be implemented system. This must be considered an essential step in understanding the wider system phenomena, but this researcher would suggest that understanding the interactions, or direct effects, between these phenomena as equally important. To achieve this, perhaps adaptations of the Technology Acceptance Model’s – TAM3 (Venkatesh & Bala, 2008) - constructs of Perceived Usefulness and Perceived Ease of Use might be employed in addition to methods such as Silver’s Reactive Analysis and Kotter’s Change Model. The TAM3 (see Figure 21) provides “a complete nomological network of the determinants of individuals’ IT adoption and use” (Venkatesh & Bala, 2008, p. 279) and as illustrated in Table 17, the TAM3 offers a wealth of questions that might be augmented so as to explore acceptance of meso- and macro-level CAF “technologies” such as policy, incentives, and implementation instruments. For example, a macro-level policy or a meso-level process change proposal might be examined with derivations of TAM3 evaluation items such as, “*Adoption of this policy in my practice will increase my productivity,*” or “*Implementation of this process change does not require a lot of my mental effort.*”

**Figure 21: The Technology Acceptance Model 3 (TAM3)**



**Table 17: Select items used to measure TAM3 Constructs**

Constructs	Items (measured on a 7-point Likert scale)
Perceived Usefulness	<ul style="list-style-type: none"> <li>• Using the system improves my performance in my job.</li> <li>• Using the system in my job increases my productivity.</li> <li>• Using the system enhances my effectiveness in my job.</li> <li>• I find the system to be useful in my job.</li> </ul>
Perceived Ease of Use	<ul style="list-style-type: none"> <li>• My interaction with the system is clear and understandable.</li> <li>• Interacting with the system does not require a lot of my mental effort.</li> </ul>

	<ul style="list-style-type: none"> <li>• I find the system to be easy to use.</li> <li>• I find it easy to get the system to do what I want it to do.</li> </ul>
Job Relevance	<ul style="list-style-type: none"> <li>• In my job, usage of the system is important.</li> <li>• In my job, usage of the system is relevant.</li> <li>• The use of the system is pertinent to my various job-related tasks.</li> </ul>
Image	<ul style="list-style-type: none"> <li>• People in my organization who use the system have more prestige than those who do not.</li> <li>• People in my organization who use the system have a high profile.</li> <li>• Having the system is a status symbol in my organization.</li> </ul>
Behavioral Intention	<ul style="list-style-type: none"> <li>• Assuming I had access to the system, I intend to use it.</li> <li>• Given that I had access to the system, I predict that I would use it.</li> <li>• I plan to use the system in the next &lt;n&gt; months.</li> </ul>

(Venkatesh & Bala, 2008)

Venkatesh and Bala discuss CAF entities such as Incentives, Organizational Support, and Training as *interventions* that have the potential to affect select determinants of technology acceptance and overall system success. For example, Incentives are discussed as having the potential to impact determinants including Perceived Enjoyment, Job Relevance and Image (Venkatesh & Bala, 2008, p. 293). Use of the TAM3 constructs and measurement items could provide a repeatable and consistent method to trace how such interventional forces/CAF entities ultimately contribute to system use. Thus, incorporation and extension of the TAM3 into the CAF evaluation toolkit may enhance its predictive and explanatory power while increasing the ability to compare results of CAF-derived evaluations.

### 6.3.2 EXTENDING THE CAF

Many times during the interviews, focus group and other interactions with the practice physicians, the role and actions of the *EMR system vendor* emerged as critical to overall system adoption and successful use. An EMR system vendor, like a group of physicians, is also subject to the wider forces within the primary health care context, particularly those macro-level forces of incentives, standards, policy and socio-cultural-economic trends. The micro-level system produced by the

EMR system vendor depends in part on how a given vendor perceives, interprets and responds to these higher forces. For instance, an EMR vendor who does not appreciate the nuances of a given healthcare standard may not promote the use of that standard within its product - perhaps by neglecting to provide an associated feature, provide adequate training, or devote resources to making the feature sufficiently usable. End users of different EMR products may emphasize different uses for those systems not merely because the users are different from one another, but because the different systems *themselves* promote certain use cases while discouraging others. In recognition of this phenomenon, it may be prudent to add the System Vendor to the meso-level entities that contribute to overall clinical system adoption.

#### **6.4 SUPPORTING IMPROVEMENTS IN EMR DATA QUALITY AND ADOPTION**

The hypothesis posed by the researcher at the project outset was that *audit-based feedback that demonstrated incentive under-utilization would result in increases in EMR adoption and subsequently, incentive utilization*. As displayed in Table 18 the feedback intervention was correlated with several modest improvements in facets of EMR adoption including EMR data quality and EMR feature utilization as well as larger improvements in incentive utilization. Overall, the null hypothesis can be considered rejected in this case.

**Table 18: Summary of post-intervention changes in EMR adoption and incentive utilization**

	<b>Direct Feedback/Support Provided</b>	<b>Extent of Relative Change</b>	<b>No Direct Feedback/Support Provided</b>	<b>Extent of Relative Change</b>
<b>Incentive related</b>	<b>Incentive Use</b>		<b>EMR Adoption: Data Quality</b>	
	1. 4-month incentive earnings versus 1-year/3-year average	<b>+64.1/ +33.5%</b>	10. Completeness: CHF Diagnoses	<b>2.8%</b>
	2. Patients seen in 4 month period versus 1-year/3-year average	<b>+38.5%/ -12.0%</b>	<b>EMR Adoption: Feature Utilization</b>	
	<b>EMR Adoption: Data Quality</b>		11. Recall Tasks for CDM purposes	<b>0.0%</b>
	3. Consistency of Capture: Condition List	<b>+7.2%</b>	12. CDM Flowsheet use	<b>-3.2%</b>
	4. Consistency of Form: Use of ICD-9 in Condition List	<b>-3.9%</b>		
	5. Completeness: Diabetes Diagnoses	<b>+4.9%</b>		
6. Completeness: COPD Diagnoses	<b>+4.2%</b>			
<b>EMR Adoption: Feature Utilization</b>				
7. CC/CD Report Accesses	<b>+800%</b>			
<b>Not related to incentives</b>	<b>EMR Adoption: Data Quality</b>		<b>EMR Adoption: Data Quality</b>	
	8. Consistency of Capture: Allergies	<b>+41.3%</b>	13. Consistency of Form: Use of coded Medications	<b>-3.6%</b>
	9. Completeness: Hypothyroid Diagnoses	<b>+192.5%</b>		

It is difficult to compare the data quality improvements observed in this study against other published results, of which there are quite few. The PCDQ programme, on which the study intervention was based, has reported improvements of 10% in documentation of ischemic heart disease, 27-fold increases in documentation of chronic kidney disease, and 87% improvements in

cholesterol recording (De Lusignan, 2007). For the most part, the improvements seen in this study were more modest. However, because the PCDQ programme studies focused on different improvement areas, utilized interventions of longer duration with more feedback cycles, and were conducted in a non-Canadian context that features many structural and technical differences from BC's EMR-enabled primary care environment, it is difficult to make a direct comparison. A recent data quality improvement initiative conducted by the Canadian North Toronto Research Network (NorTReN) produced large relative improvements in EMR data quality ranging from 35%-62% (Greiver et al., 2011). However, this project employed a data entry clerk to produce the bulk of data quality changes in response to queries produced by a resident data manager, thus again, is not directly comparable. Interestingly, though, in the one area that required changes in physician behavior (rather than effort of the data entry clerk) the observed improvements were much smaller and comparable to some seen in this project. Still, as noted by Weiskopf and Weng (2012) in their survey of data quality assessment studies, a lack of standardized terms and approaches to data quality assessment is a major barrier to performing inter-study comparisons.

Improvement was observed in use of a single EMR feature related to a CDM practice – the reporting tool. This indicates some improvement in the overall level of post-intervention EMR adoption. As indicated by physician feedback, trials of the reporting tool were encouraged after it was introduced and explained during the intervention presentation. However, a lack of improvement in use of two other CDM-related features suggests that the increase in adoption was short-lived and not linked to an enhanced CDM practice. Still, with improvements in data quality, the potential for use of advanced EMR features, and thus enhanced adoption, has grown.

In regards to improving EMR-enabled care delivery, the 33.5% improvement in incentive utilization compares favorably to the level of change observed in another recently published Canadian project that attempted to use audit, feedback and EMR training to improve delivery of preventative care services, some of which were incentivized (Maddocks et al., 2011). The Improving Practice Outcomes Via Electronic Health Records (IMPROVE) project conducted a randomized control trial with nine family practices from the Deliver Primary Healthcare Information (DELPHI) research

network in Ontario, Canada. Physician level feedback and EMR instruction was provided during a single two-hour intervention and was supplemented with custom manual that detailed how to perform relevant tasks in the EMR. One year later, no significant changes were observed and the researchers commented that a more effective intervention might have focused on fostering improvements in associated data quality. Other comparable studies were not found in the literature.

While improvements were made in both incentive utilization and in the total number of patients provided incentivized care services, it is interesting to note that gains in incentive revenues outpaced gains in services provided. During the feedback intervention, earnings differences between physicians were heavily featured in the presentation as a means to incite a desire for improved incentive utilization. Perhaps had the feedback used *patients*, rather than revenues as the primary lever for motivating change, improvement outcomes may have been different. However, as shown by the historical incentive analysis, physicians had already developed billing behaviors that exhibited preferences for high-yielding incentives.

Overall, a 4.6% median improvement was observed in incentive utilization and EMR adoption after the audit and feedback intervention. This amount compares favorably to the 1.3% median improvement found in a 2012 Cochrane review of 140 randomized trials that employed audit and feedback as a means to affect professional practice and healthcare outcomes (Ivers, 2012).

Being that the intervention followed the “same group pre-test/post-test design” and thus possessed no features of randomization to control groups, it is not possible to assign causation of the observed changes to the study’s intervention. However, in light of comments made by the practice physicians in post-intervention discussions, it is not unreasonable though to assume that some portion of the observed changes may be attributed to the intervention. Accepting this possibility, a discussion of the intervention in relation to findings from other similar audit and feedback programs discussed in the literature may provide insight into why certain effects were observed and what might be done to strengthen the intervention in any future applications.

The 2012 Cochrane review of audit and feedback interventions found that such programs were most effective in encouraging improvements in practice and care outcomes when:

1. the health professionals are not performing well to start out with (i.e., baseline performance is low);
2. the person responsible for the audit and feedback is a supervisor or colleague;
3. it is provided more than once;
4. it is given both verbally and in writing;
5. it includes clear targets and an action plan (Ivers, 2012, p. 3).

The audit and feedback program delivered within this research exhibited just two of these five characteristics – the physicians, especially in select areas, had much room to improve (#1) and the feedback intervention set relatively clear goals and included formulation of an action plan (#5). Perhaps by including the remaining three characteristics, more improvement might have been observed.

Moreover, the authors of the review cited evidence that the effectiveness of feedback may depend somewhat on the nature of the behavior that has been targeted for change. For example, feedback that aimed to change prescribing behavior was observed to be more successful than those programs designed to improve chronic disease management (2012, p. 32). No speculation is provided on why differences in target behavior are associated with audit and feedback efficacy, but it is interesting to note that the largest EMR-adoption related change resulting from this instance of audit and feedback came from increases in the consistency of allergy capture, which compared to increasing use of ICD-9 for documenting conditions or use of tasks to coordinate active recall, might be viewed as a relatively simple behavior change.

Further facets of the intervention and of the wider study context raised in Ivers et al.'s discussion may provide further explanation as to why larger changes were observed in the rate of incentive utilization compared to other changes. Firstly, use of *peer comparison* in audit and feedback has been correlated with performance increases in the majority of studies that employed the tactic

(2012, p. 24). This tactic, on recommendation from PCDQ/PRIMIS experience, was used heavily in the incentive portion of the feedback discussion. Secondly, feedback presentations that provided “extra” information that could be used to better identify patients that should be prioritized for follow-up action sometimes resulted in better improvements (2012, p. 25). In this intervention, information on how to use the EMR to identify “priority” patient billings was provided. Related to this, Ivers et. al point out that *educational interventions*, including those that include the *development of a QI plan*, often result in statistically significant improvements (2012, pp. 26–27). Finally, some audit and feedback programs that include aspects of *incentivization* have been shown to correlate with improvements (2012, p. 28). Being that the study took place in the context of the CDM incentive program, a portion of the improvement might be attributed to the association between improvement and increased access to incentives.

However, as can be seen in Table 18, not all improvements were linked to incentives. These improvements, as well as those where no feedback was provided at all, might be attributable to the previously described “ease” of change associated with making improvements in areas like allergy recording, the sizable room for improvement, or - as observed by studies of data quality in other incentivized contexts - may indicate a “spillover” effect where documentation quality increases were noted even in elements of the record not associated with the incentivization program (Sutton, Elder, Guthrie, & Watt, 2010b).

Findings from a data quality intervention study performed by seminal data quality researchers Lee and Strong (Lee & Strong, 2003) demonstrated that by ensuring data collectors understand *why* data collection practices are of high importance, one is better able to ensure that collected data will be of high quality. During the feedback presentation, efforts were made to illustrate how aspects of data collection compromised subsequent use and thus provided the physicians with knowledge of why high quality data collection ought to be prioritized. Perhaps this too played in a role in observed improvements in documentation practice.

Overall, the principles provided by the UK’s PCDQ and PRIMIS initiatives that were used to inform the design of the audit, feedback and support intervention overlapped well with the

recommendations included within the recent Cochrane publication and the findings of other improvement programs, such as that described in the Lee and Strong paper. Thus, future improvement efforts informed by all or either of the discussions would likely result in an evidenced based approach to fostering improvements.

## **6.5 STUDY LIMITATIONS**

As a single site study, the findings of this research are not immediately generalizable. Although characteristics of the practice may be considered typical of other family practices, there is no evidence available to suggest that this is the case. The convenience sampling technique used to recruit the family practice under study may in fact have generated a research site that featured atypical attitudes, EMR practices, or incentive utilization behaviors. Similarly, the results of the quasi-experiment do not prove causality between the intervention and the correlated findings. Without randomization of practices into control and experimental groups, it is not possible to link the intervention to the observed effects – the same effects might have been observed regardless of the intervention. However, the positive effects observed in conjunction with the subjective accounts of the practice participants suggest that further research may be nonetheless warranted.

Due to time limitations, further rounds of feedback and data analysis were not possible. With more time and a greater set of observations, perhaps more insight could have been made as to whether initial improvements in EMR adoption and incentive utilization persisted over time. Had the researcher been able to secure greater time with the physicians, it would have been preferable to repeat the EMR Adoption Survey to provide greater information into changes in post-intervention EMR adoption levels.

## **6.6 CHALLENGES TO SCALING THE RESEARCH APPROACH**

Three challenges may obstruct future attempts to apply the research approach used in this study. First, the researcher was fortunate to find a family practice so willing to participate in the research activity. Finding family physicians willing to dedicate time to research activities is a noted challenge for any primary care researcher (Carek & Mainous, 2008; Young et al., 2006; Zwar,

Weller, McCloughan, & Traynor, 2006). Second, the researcher was fortunate that the practice was willing to enter into an EMR data sharing agreement with researcher. Thirdly, the researcher was fortunate that the EMR vendor was willing to twice provide - *at no-cost to the researcher* -an anonymized extract of the practice's entire EMR dataset. Data access has also been cited as a major barrier to conducting EMR research in Canada (Terry et al., 2010). Challenges such as these have resulted in the past in calls to establish practice-based research networks for the purposes of supporting ongoing research in primary care (Fulda et al., 2011; Zwar et al., 2006). This researcher is supportive of those efforts. Finally, the mixed methods data collection and analytic approaches required an amount of time and effort that would be difficult to scale to a large number of practices. Again, if practice-based research networks existed that promoted common reporting interfaces and made use of available interoperability standards, the process of querying multiple EMRs for quantitative data could be made easier.

## **6.7 IDEAS FOR FURTHER RESEARCH**

Future research comparing adoption levels and incentive utilization rates between BC practices using different EMRs may prove interesting and of value to those physicians who have yet to select and adopt an EMR for their practice.

As per the recommendation of Ivers et al. Cochrane review of feedback and audit interventions, future research should aim to compare variations of audit and feedback in head to head, randomized control trials, rather than comparing audit and feedback to usual care (Ivers, 2012).

As has been demonstrated in the United States, EMRs may lead to gaming of incentive programs (R. A., Julie Creswell & Palmer, 2012). Similar notions have been suggested by UK critics of the QOF framework (Soler & Pringle, 2010). Because comments of the participating physicians indicated that a majority of physicians may bill for incentives without performing the necessary documentation, some study in this area may be warranted.

## 7 CONCLUSION

Functionality typically associated with EMRs has been shown to play a pivotal role in the effective delivery of CDM care. Structured and evidence-informed documentation templates; registries which permit for automated generation of recall lists; and passive and active reminders - when *designed, implemented and effectively incorporated into practice* – permit for superior care of patients with chronic disease. However, as has been illustrated in this mixed methods study, mere implementation of an EMR with these capabilities is not sufficient to guarantee that they will in fact be integrated into practice, even if that practice operates within an incentivized environment and even if the EMR has been integrated into practice for a number of years. Through a mixed methods exploration of EMR adoption, it was discovered that use of the EMR in this practice fell well short of the usage targets set by PITO and the Ministry of Health’s eHealth strategy, which among other things, called for regular maintenance of problem lists, use of reminders for recall, reports to support population health, and system flags to initiate regular tests (British Columbia eHealth Steering Committee, 2005, p. 23; Physician Information Technology Office, 2009).

Through CCM validation studies, incentives designed to encourage provision of care have been recognized as a key enabler in promoting improvements in CDM by family physicians. Through an application of the CAF, this study demonstrates that such incentives have indeed provided *some* level of motivation for the provision of associated CDM services by family physicians. However, the level of motivation is not such that physicians and staff are willing to spend an excessive amount of time and effort to maximize incentive-linked revenue by developing new workflows and manual workarounds for processes that are felt to be inefficiently supported by an EMR. Thus, this study suggests that provision of incentivized care may be bound to some degree by the usability of the locally installed EMR. However, lack of incentive utilization cannot be attributed to shortcomings of the EMR alone. As demonstrated here, several other factors curtail incentive use including documentation requirements that are viewed as burdensome, fear of audit, and a lack of time on the part of family physicians to devote to mastering EMR functionality, performing recall list management and the implementation of supportive administrative and clinical processes.

If the findings of this study – that EMR adoption is falling short of enabling an effective CDM practice, and that incentives are only partially successful in encouraging provision of CDM care - are believed to be reflective of the typical EMR equipped family practice in BC, then additional enablers of CDM care flagged by reviewers and implementers of the CCM may be especially important. These enablers, introduced in the first chapter, are 1) clinical information system support for small practices and 2) integration of CDM service delivery within a QI framework. The audit and feedback intervention described in this study, as well as those programs and services on which it was based (e.g. PCDQ, PRIMIS) may serve to inform design of each of these support services and QI activities.

BC is currently in a state of transitions in regard to its EMR program. PITO's mandate is shifting from one focused on implementation to one focused on use of the EMR to maximize process efficiencies and enable improved health outcomes, for example, by aiding in the delivery of improved CDM services. Similarly, the Practice Support Program is updating its QI-oriented learning modules to address EMR-equipped practice. Finally, the emergence of new organizations such as the Divisions of Family Practice and the non-profit subsidiary, the Physician Data Collaborative, signal that BC family practitioners are becoming more interested in using EMR data for research and quality improvement projects. Hopefully, the range of EMR adoption measurement and improvement techniques explored in this research may be of benefit in supporting these emerging ambitions.

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## 9 APPENDICES

### 9.1 APPENDIX A: ETHICAL APPROVAL CERTIFICATE

 <b>University of Victoria</b>	<b>Human Research Ethics Board</b> Office of Research Services Administrative Services Building PO Box 1700 STN CSC Victoria British Columbia V8W 2Y2 Canada Tel 250-472-4545, Fax 250-721-8960 Email ethics@uvic.ca Web www.research.uvic.ca	
	<h3>Certificate of Approval</h3>	
<b>PRINCIPAL INVESTIGATOR</b> Michael Bowen <b>UVic STATUS:</b> Master's Student <b>UVic DEPARTMENT:</b> HEIS <b>SUPERVISOR:</b> Dr. Francis Lau	<b>ETHICS PROTOCOL NUMBER</b> 12-021 <b>ORIGINAL APPROVAL DATE:</b> 10-Apr-12 <b>APPROVED ON:</b> 10-Apr-12 <b>APPROVAL EXPIRY DATE:</b> 09-Apr-13	
<b>PROJECT TITLE:</b> A programme to improve Electronic Medical Record data quality and its effect on family practice provision of incentivized and enhanced care for chronic disease patients <b>RESEARCH TEAM MEMBERS:</b> Dr. Francis Lau, Supervisor (UVic) Dr. Morgan Price, Committee Member (UBC)		
<b>DECLARED PROJECT FUNDING:</b> None		
<b>CONDITIONS OF APPROVAL</b> <p>This Certificate of Approval is valid for the above term provided there is no change in the protocol.</p> <p><b>Modifications</b>          To make any changes to the approved research procedures in your study, please submit a "Request for Modification" form. You must receive ethics approval before proceeding with your modified protocol.</p> <p><b>Renewals</b>          Your ethics approval must be current for the period during which you are recruiting participants or collecting data. To renew your protocol, please submit a "Request for Renewal" form before the expiry date on your certificate. You will be sent an emailed reminder prompting you to renew your protocol about six weeks before your expiry date.</p> <p><b>Project Closures</b>          When you have completed all data collection activities and will have no further contact with participants, please notify the Human Research Ethics Board by submitting a "Notice of Project Completion" form.</p>		
<h3>Certification</h3>		
This certifies that the UVic Human Research Ethics Board has examined this research protocol and concluded that, in all respects, the proposed research meets the appropriate standards of ethics as outlined by the University of Victoria Research Regulations Involving Human Participants.		
 Dr. Rachael Scarth Associate Vice-President, Research		
Certificate Issued On: 10-Apr-12		

12-021 Bowen, Michael

## 9.2 APPENDIX B: CLINICAL ADOPTION FRAMEWORK INTERVIEW QUESTIONS

The following set of questions were inspired by Silver et al's "Reactive Analysis of an Information System" (Silver et al., 1995, p. 376) in conjunction with the eHealth Observatory's Guiding Questions from Kotter's Organizational Model (see <http://ehealth.uvic.ca/methodology/metrics/metrics.php#section0-33>).

**Table X: Silver et al's "Reactive Analysis of an Information System"**

<p>Was the information system's design objective to IMPROVE the organization incrementally or to TRANSFORM it?</p> <p>-----</p> <ul style="list-style-type: none"> <li>• What are the information system's FEATURES? What does it do?</li> <li>• How does the information system FIT the firm's EXTERNAL ENVIRONMENT?</li> <li>• How does the system FIT the firm's STRATEGY?</li> <li>• How does the system FIT the firm's BUSINESS PROCESSES?</li> <li>• How does the system FIT the organizational STRUCTURE and CULTURE?</li> <li>• Can the organization's existing IT INFRASTRUCTURE support the system? <ul style="list-style-type: none"> <li>○ Does the information system leverage the infrastructure?</li> <li>○ Does it extend it?</li> </ul> </li> <li>• How and how effectively was the system IMPLEMENTED?</li> <li>• Who USES the system and how do they USE it? As intended?</li> <li>• What are the CONSEQUENCES of the system for PERFORMANCE, PEOPLE, and FUTURE FLEXIBILITY? Did the system accomplish its objectives?</li> </ul>
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**Table X: Guiding Questions from Kotter's Organizational Model**

<ul style="list-style-type: none"> <li>• Has the sense of urgency for change been established within the organization?</li> <li>• Has a guiding coalition been created within the organization?</li> <li>• Has the vision and strategy been developed within the organization?</li> </ul>
---

- Has the vision and strategy been communicated throughout the organization?
- What is the mechanism to empower broad-based action for change throughout the organization?
- What are the short-term wins for the organization that can be generated from this change?
- What are the efforts to consolidate gains and produce more change within the organization?
- How are the new approaches being anchored within the organizational culture?

On CDM Incentives:

1. Organization/People: How well do you feel you understand the CDM incentive program – e.g. patient eligibility, qualifying conditions, physician documentation and follow-up obligations? Have you ever sought out additional support or information from any group – GPSC, PSP, etc?
2. Organization/People/Benefits: How compelling is the CDM incentive program in your opinion? Do you think it is an effective use of resources? Is it financially compelling?
3. Organization/People: Has the availability of CDM incentives changed your workflow or roles in the clinic? How?
4. Organization/Culture: What's your general feeling on how completely you are providing CDM irrespective of the CDM incentive program?
5. Organization/Process: In the majority of cases, do you actively seek to identify and invite CDM eligible patients to your clinic for care, or do you treat them when they come to the clinic on their own?

On EMR:

6. Organization/System Intentions: What were your primary drivers for wanting to use an EMR?

7. Funding/Incentives: Did the existence of the CDM incentives play a significant role in your desire to adopt the EMR?
8. Organization/People: How well do you feel you understand the EMR and all of its features?
9. Service Quality: Have you found yourself needing support in using the EMR? What kind – technical, process, billing? Generally, were you able to find what you need with an acceptable level of effort?
10. Usage/Satisfaction: Generally, are you satisfied with the usefulness of the EMR?
11. System Quality: What do you think about the quality of the EMR in terms of the features offered - especially the features pertaining to:
  - a. Documentation and coding chronic disease?
  - b. Reporting and auditing the practice for chronic disease management purposes?
  - c. Billing for chronic disease incentives?
  - d. Decision support – for prescribing, ordering diagnostics, flagging care opportunities, etc?
12. Benefits: What effect has the EMR had in your practice’s ability, or desire, to take advantage of the incentives that available for family physicians?

On EMR Data Quality:

13. System Intentions: In your opinion, what characteristics make-up EMR data that is of high quality?
14. System Intentions: What role is there in your documentation practice for use of classification systems like ICD-9 or structured documentation tools like the Problem List or CDM templates?
15. Usage/Satisfaction: Is EMR data entered into patient records generally complete, accurate, sufficiently descriptive and appropriately structured to an extent that it adequately supports:
  - a. Your day to day clinical interactions with individual patients?
  - b. Shared care between providers?

- c. Decision support during clinical interactions?
- d. Case management (as in chronic disease management)?
- e. Practice reflection (using reports) and planning?

### **9.3 APPENDIX C: POST-INTERVENTION FOCUS GROUP DISCUSSION QUESTIONS**

1. Was the feedback regarding the practice's comparative incentive utilization rates useful to you?
2. Was the feedback regarding the EMR data quality useful to you?
3. Was the information provided to you about the EMR's chronic disease management reporting features useful to you?
4. After the feedback session, did you feel motivated to make changes in your incentive billing practice?
5. After the feedback session, did you feel motivated to make changes in the way the practice manages recalls for CDM patients?
6. After the feedback session, did you feel motivated to make changes in your EMR charting practice?
7. After the feedback session, did you feel motivated to make more use of the EMR CDM/CC patient report?
8. Why do you think the biggest changes were seen in Allergy List recording rates compared to the Condition List?
9. Why do think bigger changes weren't seen in incentive utilization rates?
10. Why was the CDM/CC patient report used so few times after the feedback session?
11. In general, what were the biggest enablers of and detractors from, instituting change at the practice?

## 9.4 APPENDIX D: EMR ADOPTION SURVEY SCORES

	A	B	C	D	Total Averages
<b>Health Information</b>					
1	4.0	4.0	4.0	4.0	4.0
2	2.0	2.0	2.0	3.0	2.3
3	3.0	3.0	3.0	3.0	3.0
<b>Average:</b>	3.0	3.0	3.0	3.3	3.1
<b>Medications</b>					
4	3.0	2.0	3.0	3.0	2.8
5	4.0	4.0	4.0	4.0	4.0
6	1.5	0.0	3.0	3.0	1.9
7	2.0	2.0	0.0	2.0	1.5
<b>Average:</b>	2.6	2.0	2.5	3.0	2.5
<b>Laboratory</b>					
8	0.0	0.0	0.0	2.5	0.6
9	4.0	4.0	4.0	4.0	4.0
<b>Average:</b>	2.0	2.0	2.0	3.3	2.3
<b>Medical Imaging</b>					
10	0.0	0.0	0.0	4.0	1.0
11	3.0	3.0	3.0	3.0	3.0
12	2.0	2.0	2.0	2.0	2.0
<b>Average:</b>	1.7	1.7	1.7	3.0	2.0
<b>Referrals</b>					
13	1.0	4.0	2.0	4.0	2.8
14	3.0	3.0	3.0	3.0	3.0
15	3.0	3.0	3.0	3.0	3.0
16	3.0	1.5	3.0	3.0	2.6
<b>Average:</b>	2.5	2.9	2.8	3.3	2.8
<b>Decision Support</b>					
17	2.0	0.0	0.5	2.0	1.1
18	1.0	1.0	0.0	2.0	1.0
19	2.0	2.0	2.0	2.0	2.0
20	4.0	4.0	0.0	4.0	3.0
<b>Average:</b>	2.3	1.8	0.6	2.5	1.8
<b>Electronic Communication and Connectivity</b>					
21	1.5	1.5	0.0	3.0	1.5
22	4.0	0.0	3.0	3.0	2.5
23	3.0	3.0	3.0	3.0	3.0
<b>Average:</b>	2.8	1.5	2.0	3.0	2.3
<b>Patient Support</b>					
24	1.0	1.0	1.0	1.0	1.0
25	1.0	1.0	1.0	1.0	1.0
<b>Average:</b>	1.0	1.0	1.0	1.0	1.0
<b>Administrative Processes</b>					
26	4.0	4.0	4.0	4.0	4.0

<b>27</b>	3.0	1.0	1.0	3.0	2.0
<b>28</b>	0.0	0.0	0.0	0.0	0.0
<b>29</b>	4.0	4.0	4.0	4.0	4.0
<b>Average:</b>	2.8	2.3	2.3	2.8	2.5
<b>Reporting and Population Health Management</b>					
<b>30</b>	3.5	3.5	3.5	3.0	3.4
<b>31</b>	3.5	3.0	3.0	1.0	2.6
<b>Average:</b>	3.5	3.3	3.3	2.0	3.0
<b>Overall Stage:</b>	2.4	2.1	2.1	2.7	2.3

## 9.5 APPENDIX E: PHYSICIAN LEVEL PREVALENCE AND INCENTIVE UTILIZATION RATES

**Table X: Disease Prevalence Rates by Physician**

	2007	2008	2009	2010	2011
	Diabetes				
<b>A</b>	9.3%	8.8%	10.8%	12.4%	12.0%
<b>B</b>	3.7%	3.5%	4.0%	4.4%	4.8%
<b>C</b>	4.0%	7.1%	9.7%	10.5%	12.7%
<b>D</b>	--	--	5.8%	5.9%	6.0%
	Congestive Heart Failure				
<b>A</b>	0.9%	1.0%	1.3%	1.4%	1.4%
<b>B</b>	1.0%	1.0%	0.9%	1.5%	1.6%
<b>C</b>	1.4%	1.0%	0.9%	1.2%	1.2%
<b>D</b>	--	--	3.3%	2.6%	2.7%
	COPD				
<b>A</b>	2.4%	2.5%	2.7%	2.4%	2.4%
<b>B</b>	1.2%	2.1%	3.0%	3.1%	3.6%
<b>C</b>	0.2%	1.6%	2.9%	3.2%	3.5%
<b>D</b>	--	--	0.6%	1.0%	1.5%

**Note:** Physician D did not use the EMR fully until 2009, thus the prevalence rates are not accurate before then.

**Table X: Incentive Utilization Rates by Physician**

	2007	2008	2009	2010	2011
	Diabetes				
<b>A</b>	62.7%	77.2%	79.4%	60.0%	29.3%
<b>B</b>	36.4%	37.9%	31.3%	62.9%	30.8%
<b>C</b>	11.8%	68.8%	51.6%	30.0%	48.8%
<b>D</b>	--	--	92.5%	81.5%	81.8%
	Congestive Heart Failure				

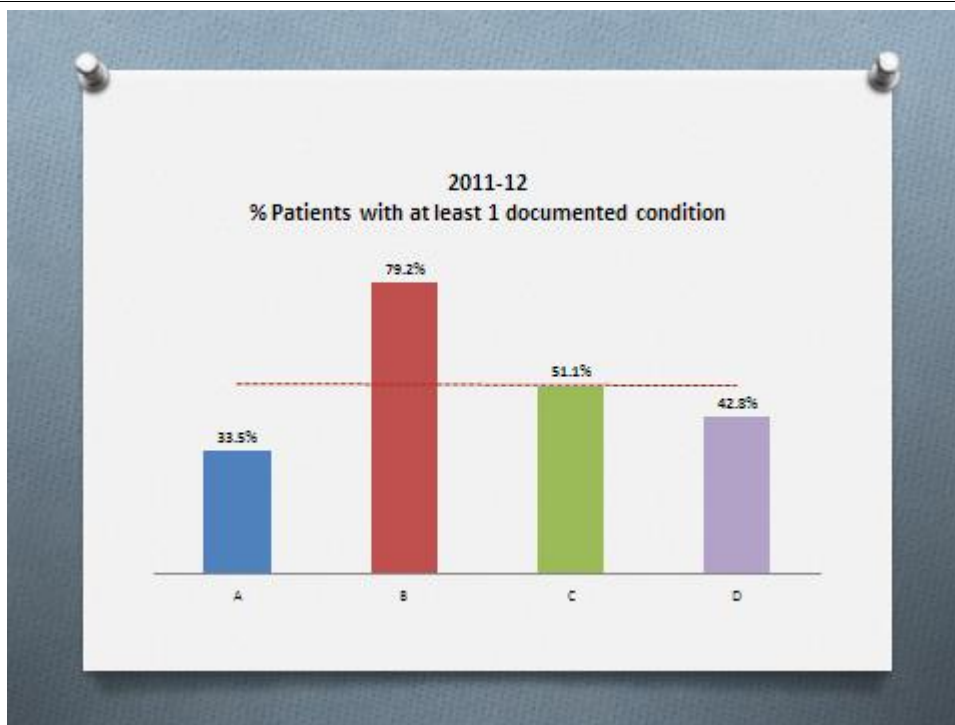
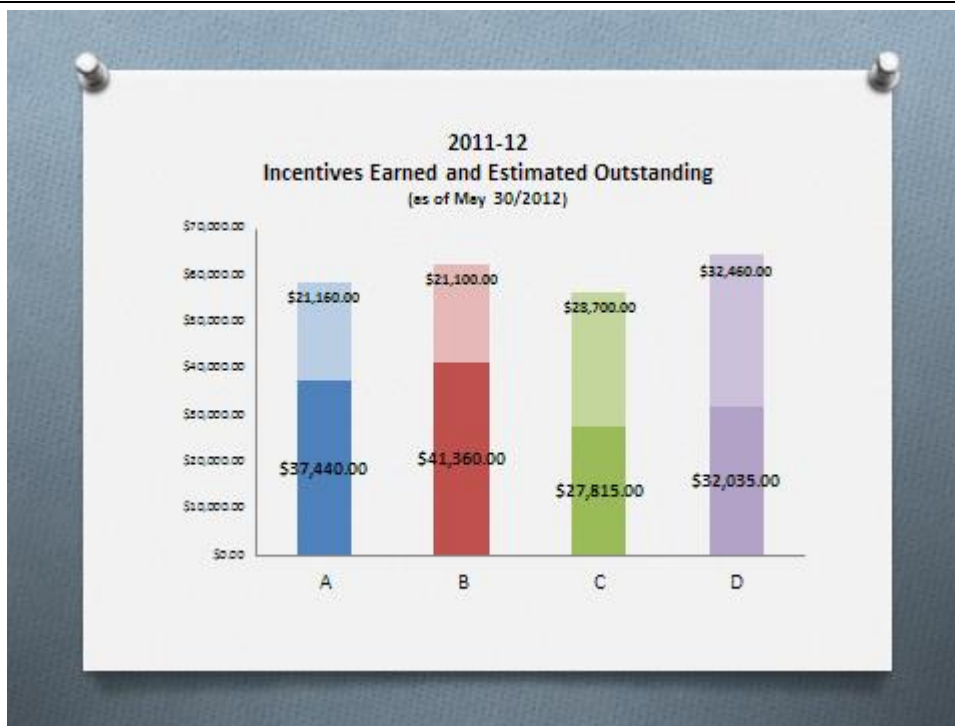
<b>A</b>	0.0%	0.0%	33.3%	15.4%	0.0%
<b>B</b>	0.0%	12.5%	28.6%	16.7%	15.4%
<b>C</b>	0.0%	28.6%	16.7%	0.0%	12.5%
<b>D</b>	--	--	66.7%	25.0%	44.0%
	COPD				
<b>A</b>	0.0%	0.0%	0.0%	13.6%	13.0%
<b>B</b>	0.0%	0.0%	0.0%	8.0%	3.4%
<b>C</b>	0.0%	0.0%	0.0%	4.8%	0.0%
<b>D</b>	--	--	20.0%	11.1%	14.3%

Note: **Physician D did not use the EMR fully until 2009, thus the prevalence rates are not accurate before then.**

## 9.6 APPENDIX G: SELECT INTERVENTION PRESENTATION SLIDES

Table X: Select Intervention Slides





The screenshot shows a software window with the following data:

CCID	Last Reg'd	First Reg'd	Sex	Birthdate	Type	Registered Doctor	Diagnostic Codes	Billings	Max	Last Billed Date	Incentive Group
CD	Arken	Alton	M	Sep 23 1987	R	DEM Diane Munn	401	0	1	Feb 01 2010	CDM - DDI w/ Hlo Incentive
CC	Al	William	M	Sep 23 1987	R	DEM Diane Munn	410,595	0	1		Complex Case Annual Managem...
CC	Andres	Juan	F	Jun 27 1928	R	DEM Diane Munn	292,870,436,AA...	0	1	Mar 16 2009	CDM - DDI w/ Hlo Incentive
CD	Andres	Juan	F	Jun 27 1928	R	DEM Diane Munn	292	0	1		CDM - DDI w/ Hlo Incentive
CD	Andres	Juan	F	Jun 27 1928	R	DEM Diane Munn	436	0	1		CDM - COPD Incentive
CD	Andres	Alton	M	Jun 10 1932	T	Chf/Conth/M...	292,290,292	0	1		CDM - DDI w/ Hlo Incentive
CD	Asst	Diana	F	May 02 1940	R	Chf/Conth/M...	292	0	1		CDM - DDI w/ Hlo Incentive
CC	Baker	Juan	F	Jun 14 1977	R	DEM Diane Munn	292,595	0	1		Complex Case Annual Managem...
CD	Baker	Juan	F	Jun 14 1977	R	DEM Diane Munn	292	0	1		CDM - DDI w/ Hlo Incentive
CC	Stallard	Temp	M	Mar 12 1938	R	Chf/Conth/M...	292,670	0	1	Jan 08 2009	Complex Case Annual Managem...

Code	Problem	Start	Service Date	Ins	Service Code	Diagnostic Code(s)	Billing Doctor	Claim #	St
436	CHRONIC AIRWAYS OBSTRUCTI...		Jan 13 2009	BC	1400	A414,250	DEM Diane Munn	2267	U

According to my analysis of your data...

**88%** of patients prescribed an Insulin have Diabetes on the condition list

**70%** of patients prescribed Spiriva have some variant of COPD on the condition list

**27%** of patients prescribed Synthroid have Hypothyroidism or Goiter on the condition list

**From what I understand these should each be very close to 100%.**

Diabetes (250) as a **billing diagnosis**

“heart failure - dx. 2010” on the **Condition List**

+

250

=

CDM: 14050

This patient appears to qualify for one incentive (but really it should be **three!**)

ICD-9-CM	ICD-9-CM Description	ICD-9-CM Category	ICD-9-CM Code	ICD-9-CM Code Description	ICD-9-CM Code	ICD-9-CM Code Description
250	Diabetes mellitus	250	250.0	Diabetes mellitus without mention of complication	250.0	Diabetes mellitus without mention of complication
250	Diabetes mellitus	250	250.1	Diabetes mellitus with hyperglycemia	250.1	Diabetes mellitus with hyperglycemia
250	Diabetes mellitus	250	250.2	Diabetes mellitus with ketoacidosis	250.2	Diabetes mellitus with ketoacidosis
250	Diabetes mellitus	250	250.3	Diabetes mellitus with chronic kidney disease	250.3	Diabetes mellitus with chronic kidney disease
250	Diabetes mellitus	250	250.4	Diabetes mellitus with neuropathy	250.4	Diabetes mellitus with neuropathy
250	Diabetes mellitus	250	250.5	Diabetes mellitus with retinopathy	250.5	Diabetes mellitus with retinopathy
250	Diabetes mellitus	250	250.6	Diabetes mellitus with nephropathy	250.6	Diabetes mellitus with nephropathy
250	Diabetes mellitus	250	250.7	Diabetes mellitus with osteopathy	250.7	Diabetes mellitus with osteopathy
250	Diabetes mellitus	250	250.8	Diabetes mellitus with other specified complication	250.8	Diabetes mellitus with other specified complication
250	Diabetes mellitus	250	250.9	Diabetes mellitus with unspecified complication	250.9	Diabetes mellitus with unspecified complication
250	Diabetes mellitus	250	250.99	Diabetes mellitus with unspecified complication	250.99	Diabetes mellitus with unspecified complication

### 3 challenges

- Increase billing of CDM/CC incentives by incorporating use of CDM/CC reporting tool
- Increase number of CDM/CC conditions recorded using ICD-9 codes
- Reduce empty allergy records

