Family-centered care delivery: Comparing models of primary care service delivery in Ontario

Liesha Mayo-Bruinsma

Thesis submitted to the Faculty of Graduate and Postdoctoral Studies in partial fulfillment of the requirements for the MSc degree in Epidemiology

Department of Epidemiology and Community Medicine
Faculty of Medicine
University of Ottawa

Abstract

Family-centered care (FCC) focuses on considering the family in planning/implementing care and is associated with increased patient satisfaction. Little is known about factors that influence FCC. Using linear mixed modeling and Generalized Estimating Equations to analyze data from a cross-sectional survey of primary care practices in Ontario, this study sought to determine whether models of primary care service delivery differ in their provision of FCC and to identify characteristics of primary care practices associated with FCC. Patient-reported scores of FCC were high, but did not differ significantly among primary care models. After accounting for patient characteristics, practice characteristics were not significantly associated with patient-reported FCC. Provider-reported scores of FCC were significantly higher in Community Health Centres than in Family Health Networks. Higher numbers of nurse practitioners and clinical services on site were associated with higher FCC scores but scores decreased as the number of family physicians at a site increased.

(Word Count = 150; Allowed = 150)

Acknowledgements

I would like to thank my supervisors, Drs. Bill Hogg and Monica Taljaard, for their exceptional advice, expertise and support throughout the project. I would particularly like to thank Bill for continuing to push me to seek out opportunities to enrich my studies and get input from a broad audience by presenting my work at conferences across Canada. I also want to especially thank Monica for her tireless and detailed revisions of my work and for always encouraging me to be clear and concise. Without the two of them this thesis would never have been possible.

I would also like to thank Dr. Simone Dahrouge for her help and advice, particularly early on in the thesis when I was trying to wrap my head around the massive undertaking that was the Comparison of Models of Primary Care project. Thanks for always being available to answer questions and help sort out my approaches to the dataset.

The faculty members of the Department of Epidemiology and Community Medicine also deserve thanks for providing me with the formal training and skills to be able to carry out this thesis project.

Lastly, I would like to thank my family and friends for their support and encouragement throughout the process, even on days when any mention of my thesis was a taboo subject.

Table of Contents

Table of Tables

Table of Figures

Acronyms used in this Thesis

CHC	Community Health Centre
COMP-PC	Comparison Of Models of Primary Care
FCC	Family- Centered Care
FFS	Fee for Service
FHN	Family Health Network
FTE	Full Time Equivalent
GEE	Generalised Estimating Equations
HSO	Health Service Organization
LICO	Low Income Cut Off
PCAT	Primary Care Assessment Tool

Chapter 1: Introduction

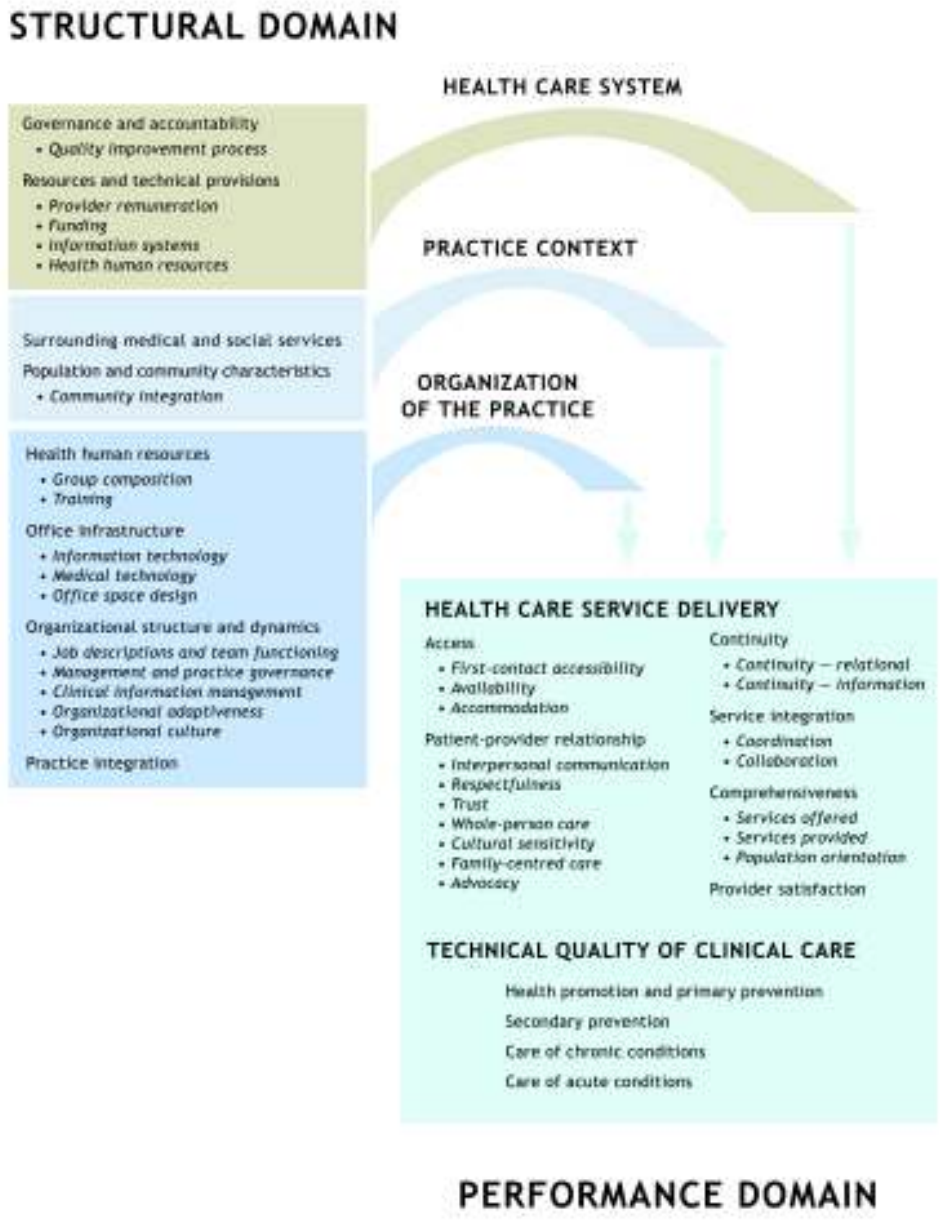
1.1 Background

Primary Care and Primary Health Care are terms often used interchangeably, however they denote two separate but related concepts. Primary Health Care includes broader influences on health at a population level, including social and public health policies alongside the more medically oriented Primary Care services[1]. Primary Care refers to "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 co-ordinates or integrates care provided elsewhere by others'[2], In Canada, Primary Care is familiar to most as a "family-doctor" style medical practice. The narrower concept of Primary Care, as opposed to Primary Health Care, is what is being evaluated in this thesis.

Primary care service delivery is complex; several authors have tried to deconstruct it into different dimensions [2-9]. The conceptual framework used in this thesis is from Hogg et al which incorporates the importance of structural and performance domains when assessing the function of primary care service delivery[6](Figure 1). One of the components of the performance domain is health care service delivery. The patient-provider relationship is a dimension of this and includes family-centered care as a sub component.

This chapter defines family-centered care and outlines what the literature shows about factors that influence its provision in primary care; it introduces four primary care service delivery models and provides a rationale for studying the relationship between the provision of family-centered care and the organization of primary care service delivery.

Figure 1: Conceptual framework of Primary care organizations. As shown in Dahrouge et al[10]; adapted from Hogg et al[6]. Reproduced with permission of the journal and Oxford University Press.



1.2 What is Family-centered Care?

Family-centered care in the primary care setting involves the consideration of the family in managing a clinical case[11]. This could include, for example, consideration of hereditary conditions in the patient's family, household income and living situations, being aware of signs of child abuse, as well as direct consultation with the family. While direct involvement of the family in clinical discussions can be part of family-centered care if the patient desires it, it is not essential, as the critical element of this concept is viewing the patient in the family context. Viewing patients in their family context can increase the physicians' effectiveness in helping patients manage illness, as in the following example from Starfield[2].

> "A 20-year-old unskilled manual worker with an obscure skin rash was referred to a dermatologist by an ophthalmologic surgeon. He was treated unsuccessfully over many weeks until seen by his general practitioner, who confirmed that the patient shared a bed with his brother. The brother also had a rash, and both itched more at night. The general practitioner was thus able to diagnose and control the underlying scabies. - A clinical experience".

In this case, knowledge of the family situation allowed the physician to appropriately treat both individuals and resolve the problem.

There is some evidence that family-centered care in the primary care setting may be associated with increased patient satisfaction[12].In their 2006 paper, Ngui et al used data from a national, population-based survey of parents of children with special health care needs in the US to identify factors that influence their satisfaction with healthcare services. Adequacy of family-centered care had a significant influence on satisfaction with care and ease of using healthcare services. As the study did not differentiate between primary and specialty

services in their survey, this should not be considered strong evidence of an association in primary care, but rather an indication that a relationship between family-centered care and satisfaction with healthcare services may exist. The concept of family-centered care in the critical care and paediatric literature is fairly well established though less broadly defined than in the primary care-setting. In these contexts, patient limitations due to age or critical illness mean that the family may be involved in order to make decisions regarding care and ensure that the necessary treatments are carried out [13,14]. Family-centered care has been associated with improved clinical outcomes and increased patient satisfaction in these settings [13,15]. In a randomized controlled trial of family-centered preparation for surgery, Kain et al found that children who received family-centered preparation had less anxiety before the procedure, and following the procedure had lower incidence of severe emergence delirium and required less analgesics than children receiving either regular care, anti-anxiety drugs or parental presence. In a randomized controlled trial of adolescents with bulimia nervosa, Le Grange et al found that those who demonstrated lower levels of eating disorder psychopathology were more likely to improve if they received family-based treatment compared to those receiving individual supportive psychotherapy. The broader definition of family-centered care in the primary care setting described previously, that is, the consideration of the family in managing a clinical case, is the concept that will be explored in this thesis.

Consideration of the family is fundamental to the Institute of Medicine's[16] definition of primary care which requires a physician to view their patients within the context of family and community. While there are several medical disciplines that provide primary care (e.g. general internists, obstetricians and gynaecologists and paediatricians) and several allied

health professions (e.g. nurse-practitioners, social workers and dieticians), in Canada, family medicine is arguably the most important. Family-centered care, as a dimension of the patient-provider relationship, is implicit in the four principles of family medicine espoused by the College of Family Physicians of Canada[17], one of which dictates that the "The patient-physician relationship is central to the role of the family physician". A review of the literature was conducted for this project with the guidance of a librarian (LAU) in the Health Sciences Library at the University of Ottawa. The PubMed – Medline database was searched and the search strategy, including keyword search terms, is presented in Appendix A. The titles and abstracts of the 868 articles returned by this search were reviewed. Articles were excluded if they did not mention the family; focused only on defining primary care or the role of a family physician; focused only on family planning or adolescent pregnancy; were epidemiological reports on patient or family characteristics; examined the organization of hospital services; or were older than 1990. A total of 32 articles were identified for further review. In addition, the bibliography on adult health care and a list of selected references from the Institute for Family-Centered Care[18,19] were consulted to identify further articles that might be relevant. The majority of the literature reviewed addressed family-centered care in hospital situations, typically in critical care or paediatrics; described the theory of family-centered care; or described methods for implementing FCC in an organization. At least two articles indicated that, despite the stated importance of this concept, there was a lack of research in the field [20,21]. No articles were identified that examined organizational or other related factors that influence the provision of family-centered care. Even looking at the broader concept of patient centered care as recently as 2010, in their literature review for an extensive analysis of secondary datasets Goldberg and Mick found no previous research

assessing the relationship between organizational characteristics of healthcare and patient-centered care[22].

1.3 Primary Care Service Delivery Context

Substantial diversity in the organization of primary care services exists at a global, national and even at a provincial level. Efforts in primary care reform have created a natural experiment in the province of Ontario, Canada, where a major proliferation of different models of primary care service delivery has occurred[23]. Because the different models for organizing primary care services are within the same geo-political jurisdiction, this provides a special opportunity in which to study the provision of primary care services. The organization and remuneration of primary care services have been found to influence many aspects of quality of care and provider behaviour[24-26]. As efforts continue to improve the delivery of primary care[27], the importance of determining how the organization of primary care service delivery influences the provision of family-centered care becomes apparent.

In 2006, the four principal models of primary care service delivery in Ontario were Fee-For-Service (FFS), Health Service Organizations (HSO), Community Health Centers (CHC) and Family Health Networks (FHN).

1.3.1 Models of Primary Care Service Delivery

These four models of primary care service delivery differ in their remuneration methods, organization and priorities. Though details of these models and their inherent incentives and

disincentives have been more thoroughly described elsewhere[23,28] a brief description of each model type will be provided here.

1.3.1.1 Fee-For-Service (FFS)

The traditional FFS model still dominates and as of 2004, 52% of physicians in Canada were paid via a fee-for service scheme[29]. In Ontario in 2006 this was by far the most common model of primary care service delivery serving over 9 million patients[23]. Fee-for-service refers to the remuneration method where physicians bill for each activity. This model can include either single physicians or groups of physicians. Practices occasionally work with allied health professionals such as nurses and nurse practitioners. Physicians do not roster their patients and receive few, if any, incentive payments for providing preventive care[23].

1.3.1.2 Health Service Organizations (HSO)

HSOs have been operating in Ontario since 1975 and, in 2006, served 255,000 patients [23]. Capitation based payment systems are employed in HSOs where physicians are required to roster their patients and are paid a set fee for each patient, in addition, they may receive incentives for prevention activities. HSOs are further characterised by having a provider-led governance structure, after-hours access for patients, and sometimes employing allied health professionals such as nurses or nurse-practitioners [23]. It is important to note that while HSOs were in use in 2006, in 2010 they are no longer being used in Ontario, having transitioned to a new but similar model called Family Health Networks.

1.3.1.3 Community Health Centers (CHC)

CHCs were introduced in the mid 1970's and became well established in the early 1980's. In 2006 they served 230,000 patients across Ontario. Physicians are salaried and can also

receive incentive payments for providing prevention activities. CHCs are further characterised by having a governance structure made up of a community board and employing allied health professionals such as nurses or nurse-practitioners. Additionally, they may have after-hours access for patients and they may receive some incentives to incorporate information technology such as electronic medical records[23].

1.3.1.4 Family Health Networks (FHN)

FHNs were more recently developed and have been used in Ontario since 2001. In 2006 they served a population of 550,000 patients[23]. Remuneration in these models is a blending of capitation and fee-for-service-type incentives including specific incentives for prevention activities and the incorporation of information technology. FHNs are further characterised by having a governance structure which entails a provider-led contract with the Ontario Ministry of Health and Long-Term Care, having after-hours access for patients and possibly having allied health professionals such as nurses or nurse-practitioners[23].

Chapter 2: Study Objectives

2.1 Objective 1

Determine whether models of primary care service delivery differ in their provision of family-centered care.

The first objective of this study is to determine how the four models of primary care service delivery (FFS, FHN, CHC, HSO) differ in terms of (a) provider-reported family-centered care, and (b) patient-reported family-centered care.

2.2 Objective 2

Identify organizational characteristics of primary care practices associated with family-centered care.

The second objective of this study is to identify organizational characteristics, such as number of nurses on staff or after-hours telephone access, that are associated with higher (a) provider-reported family-centered care, and (b) patient-reported family-centered care.

Chapter 3: Methods

This thesis is a secondary analysis of data collected through the Comparison of Models of Primary Care in Ontario project (COMP-PC) hereafter referred to as "the original study". In addition to describing the methods for this thesis, this chapter will provide a brief overview of the methods for the original study.

3.1 Original Study - Comparison of Models of Primary Care in Ontario (COMP-PC)

Details of these methods are extensively described by Dahrouge et al[10] (Appendix B). Though the original study used data obtained from multiple sources, including medical chart reviews, interviews and survey instruments, only information on the data collection relevant to this thesis will be presented here. The original study was approved by the Ottawa Hospital Research Ethics Board.

3.1.1 Setting

The original study was carried out in the province of Ontario, Canada, which had a population of 12.6 million at the time. In Canada, insurance for medically necessary healthcare, termed 'Medicare', is mandated at the national level through the Canada Health Act but administered by provincial governments[30]. Medicare is funded through tax dollars and covers hospital treatment and physician services irrespective of an individual's income or ability to pay.

3.1.2 Study Design

A cross-sectional, practice-based survey was administered to primary care practices, their providers and patients, belonging to four models of primary care delivery in Ontario. A

stratified multi-stage survey strategy was employed where the strata were the different model types and the primary selection unit was the practice. The survey was administered between June 2005 and June 2006.

3.1.3 Sample Size

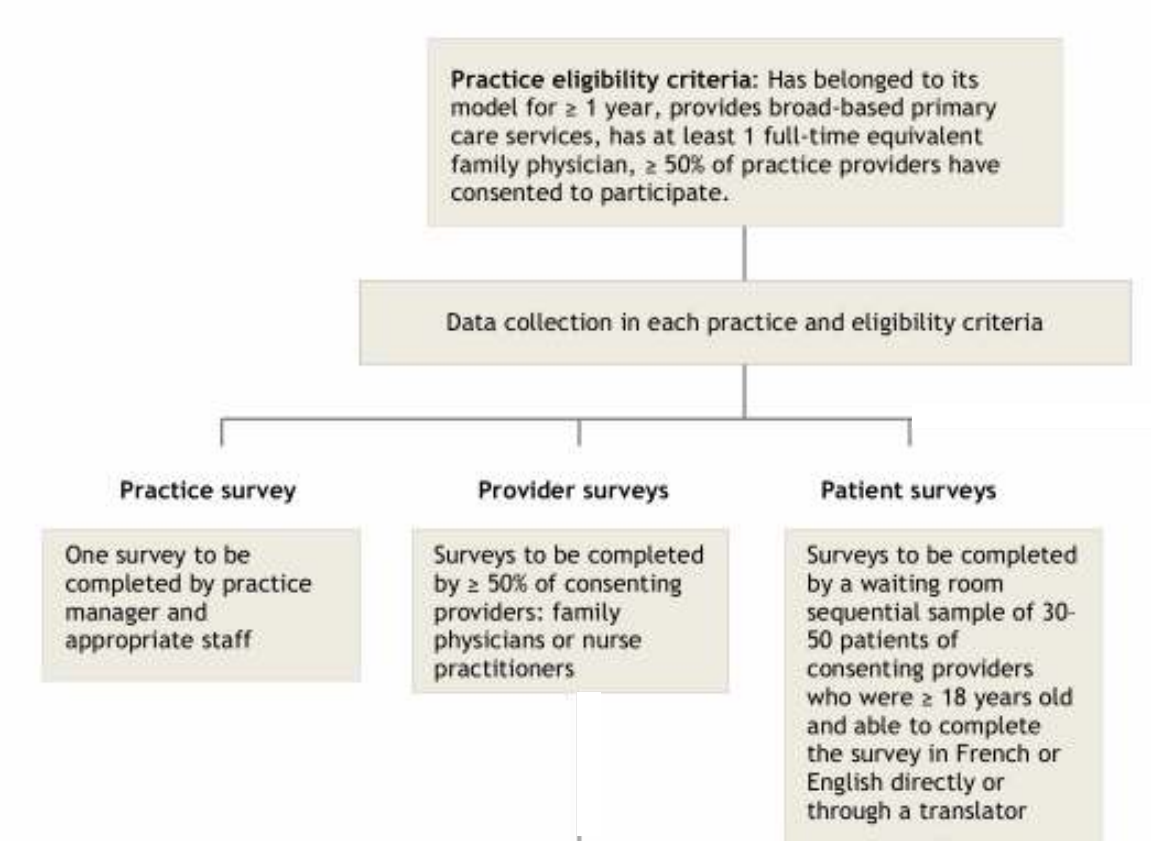
As many different aspects of primary care were assessed in the original study, target patient sample size was determined based on the measure of disease prevention performance as this was expected to require the greatest number of observations. "Sample size was calculated using a clinically important difference of 0.5 standard deviation, with an alpha level of 0.05 and a beta level of 0.20, and was chosen to control for the family-wise error rate and variance of the cluster (cluster correlation coefficient of 0.2)"[10]. A recommended sample size of 40 practices per model with a minimum of 30 patients per practice was determined. Due to time and logistical constraints the sample size was reduced to 35 practices per model and a target of 50 patients per practice was employed in order to offset the reduction in number of practices[31]. Therefore the total target sample size for the original study was 7,000 patients as indicated below.

$$50_{\text{patients}} \times 35_{\text{practices}} \times 4_{\text{models of service delivery}} = 7{,}000 \text{ patients}$$

3.1.4 Eligibility and Sampling

The general eligibility criteria and sampling approach are shown in Figure 2.

Figure 2: **Practice, provider and patient eligibility for COMP-PC. Adapted from Dahrouge et al[10]. (Open Medicine is an open access journal that applies the Creative Commons Attribution Share Alike License which allows unrestricted reuse and alteration of their published works provided the authors and journal have been appropriately credited).**



3.1.4.1 Practices

Logistical constraints precluded the recruitment of practices in the sparsely populated far north of the province. All CHC, HSO and FHN practices from across the province (n = 53, 69 and 104 practices respectively) along with a random sample of 155 eligible FFS practices were approached to participate. This represents practices serving approximately 90% of the population of Ontario at the time the study was carried out.

3.1.4.2 Providers

Once a representative for a practice expressed interest in participating, they were responsible for recruiting other eligible providers within that practice. As long as >50% of the providers within the practice consented to take part, the practice was eligible to participate in the study. The profiles of participating family physicians were compared to the profiles of all Ontario family physicians practicing in these models using health administrative databases (physician workforce database; Ontario Health Insurance Plan (OHIP)) to determine whether selection bias related to practice refusal or if provider self-selection was present.

3.1.4.3 Patients

Patients of consenting physicians were recruited sequentially in the waiting room. This technique has an inherent bias towards over-sampling of patients who visit their primary care provider more frequently, such as older patients, women and those with a chronic illness. See Figure 2 for further details of patient eligibility criteria.

3.1.5 Survey Instruments

Surveys were administered to practices, providers and patients. These surveys were adapted from the adult edition of Starfield's Primary Care Assessment Tool (PCAT) full and abridged versions, in order to measure the quality of the different dimensions of primary care service delivery[32,33]. Figure 1 shows Hogg et al's conceptual framework for the organization of primary care[6], dimensions of which are specifically measured in the PCAT. The full version of the PCAT was validated in 2001[34]. Component factor analysis was used to assess construct validity of the scales and Cronbach's coefficient alpha was used to assess their internal consistency and reliability[34]. Though there were several different dimensions

of primary care service delivery measured in the original study, only the measure of family-centered care was used in this thesis (see 3.3 Primary Outcomes and Appendix C).

3.1.6 Data Quality Monitoring

Data from the practice and provider surveys were entered in the database twice independently by two members of the research team to ensure the accuracy of data entry; any discrepancies were checked and corrected. In addition, for all tools used, the data entered was verified[10]. For a more comprehensive description of measures taken to ensure data quality throughout the original study, please see Dahrouge et al[10](Appendix B).

3.2 Creation of Dataset

The data from the original study had been cleaned and all potential identifying information was removed prior to access being granted to the author. Approval for access to data was granted by the data custodian (Dr. William Hogg). Data from the original study was accessed in the form of three data tables containing the results of each survey instrument (patient, provider, practice). The population of patients and providers used for this thesis project was a subset of the participants in the original study. The eligibility of patients and providers included in this thesis was restricted based on their completion of the questions making up the family-centeredness scales in the two surveys (see 3.3 Primary Outcomes and Appendix C). Participants, both patient and provider, were excluded if they responded to fewer than 50% of the questions making up the FCC scale.

Data from the practice survey was merged with each of the other two datasets so that two datasets existed, one for the patients and one for the providers, each including practice-level information. Patient-level data could not be merged with provider-level data as the necessary

identifiers to merge the datasets, such as which provider the patient regularly saw, were not collected.

3.3 Primary Outcomes

3.3.1 Provider-Reported Family-Centeredness Score

The primary outcome at the provider level is a family-centeredness score based on an instrument in the provider survey, which was taken from the validated full version of the Primary Care Assessment Tool (PCAT) – Adult Edition[32]. The provider-reported family-centeredness scale is made up of a series of 14 questions related to attitudes and processes of family-centered care. The first three questions are common to both patient and provider surveys with appropriate changes in language. They are: 1) Does your office ask the patients about their ideas and opinions when planning treatment and care for the patient or family member? 2) Does your office ask about illnesses or problems that might run in the patient's families? 3) Is your office willing and able to meet with family members to discuss a health or family problem? The remaining 11 questions relate to processes of care and are unique to the provider survey. They are: "How often are each of the following included as a routine part of your health assessment? *Use of:* Family genograms, Family APGAR. *Discussion of:* Family health risk factors (e.g. genetics); Family economic resources; Social risk factors (e.g. loss of employment); Living conditions (e.g. working refrigerator, heat); Health status of other family members; Parenting. *Assessment of:* Signs of child abuse; Indications of family in crisis; Impact of patient's health on family functioning; Developmental Level. (Appendix C)

All questions have five level Likert scale responses ranging from "Definitely" to "Definitely Not" with an option of "Not Sure/Don't Know". Responses that indicated "Not Sure/Don't

Know" were treated as missing, this approach is consistent with that used in the validation of the PCAT[34] and is consistent with other analyses conducted within the original COMP PC study. Following the methods indicated in the validation of the PCAT, the responses for each set of questions were aggregated to give a score out of 56 (14 items with 4 levels each)[34]. Scores were converted to proportions so that scores of provider-reported family-centeredness ranged between 0 and 1.0.

As mentioned previously, subjects were excluded if fewer than 50% of the items making up the scale were answered. Those with more than 50% of the questions answered were included, and their scores were calculated based on the number of questions they answered. For example, if only nine of the fourteen questions were answered then the aggregate of those nine responses were taken out of a total of (9_{items}x 4_{levels}) = 36, rather than out of 56 as based on the fourteen questions that should have been answered. Failure to take this into account would have resulted in artificially lower scores for those who did not complete all items in the scale. Converting the raw scores to percentages allowed comparisons to be made despite differing numbers of responses.

3.3.2 Patient-Reported Family-Centeredness

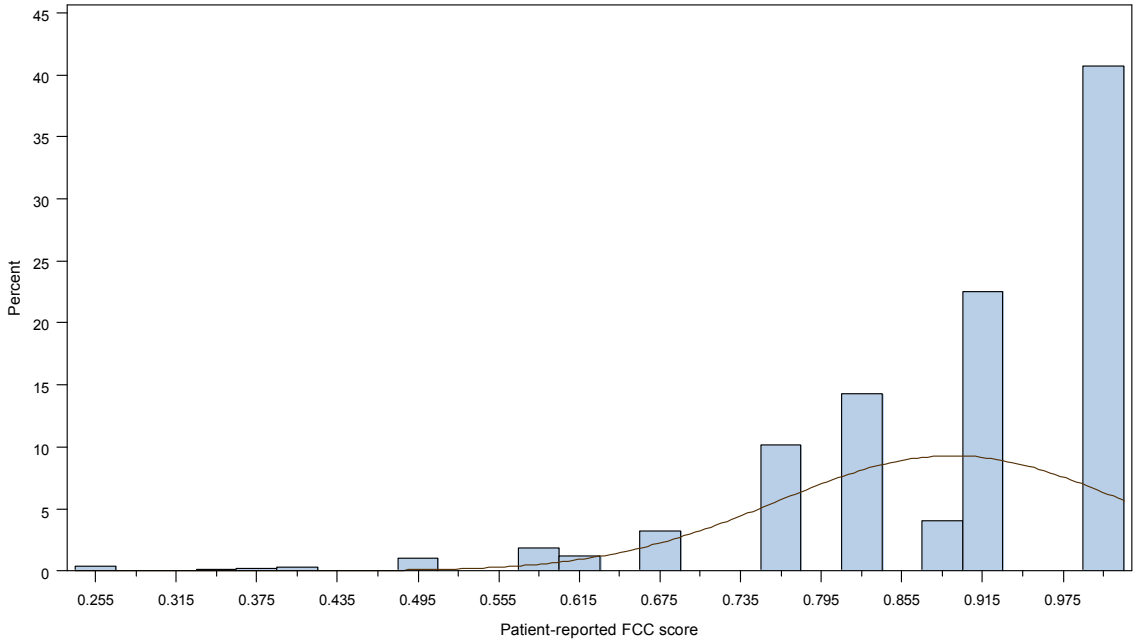
The primary outcome at the patient level is based on a scale in the patient survey, which was taken from the validated full version of the PCAT (see 3.3.1 Provider-Reported Family-Centeredness Score). This scale measures patient-reported family-centeredness and is made up of a series of three questions on family-centered care in the patient survey. These questions are similar to the first three questions in the provider survey with appropriate changes in language. They are: 1) Does your provider ask you about your ideas and opinions when planning treatment and care for you or a family member? 2) Has your provider asked

about illnesses or problems that might run in your family? 3) Would your provider meet with members of your family (or friends) if you thought it would be helpful? As in the provider survey, all questions have five level Likert scale responses ranging from "Definitely" to "Definitely Not" with an option of "Not Sure/Don't Know". Responses that indicated "Not Sure/Don't Know" were treated as missing, this approach is consistent with that used in the validation of the PCAT tool[34] and is consistent with other analyses conducted within the COMP-PC project. The responses to these questions were aggregated to give a score out of 12 for the patient scale (3 items with 4 levels each).

Although the original intention had been to calculate a patient-reported FCC score similar to the provider score, initial investigations indicated that the assumption of a normal distribution of the patient FCC scores was violated. Upon visual examination, there appeared to be a ceiling effect in the distribution of FCC scores with most scores clustered near the top end of the scale (Figure 3). FCC scores also appeared to be discretely, rather than continuously, distributed which was likely a function of the small number of questions making up the scale. Log transformation of the continuous scores was attempted, however, this did not substantially improve the spread of the data. The decision was made to dichotomize patient-reported FCC using the following method. As with provider-reported FCC, all those who answered fewer than 50% of the questions were excluded from the analysis. Patients who answered "Definitely" to at least two out of the three questions and no worse than "Probably" on the other question were considered to report family-centered care. This rule was extrapolated to those patients with one missing response as follows.

Since patient responses of "Not Sure/Don't Know" had already been coded as missing in the original datasets accessed for this thesis, and were therefore indistinguishable, missing

Figure 3: Histogram of patient-reported FCC scores with superimposed normal distribution.



responses were considered equivalent to "Not Sure/Don't Know". If the patient had one missing response, this was considered to be reporting non-family-centered care under the assumption that a missing response indicated a lack of certainty regarding a particular question and was therefore not reporting a positive response. This assumption was checked by examining the difference in distribution of responses to the three questions for patients with one missing response compared to those who had answered all three questions. Based on chi-square tests of independence, the distribution of responses varied significantly depending on whether a patient had a missing response or had answered all the questions ($p < 0.0001$). Patients with one missing response were more likely than those who had

answered all three questions to give "Definitely Not" or "Probably Not" as answers, while those who had answered all questions were much more likely to have given "Definitely" as a response than those who hadn't. This therefore lends support to the idea that patients with one missing response tended to give more negative answers than those who had answered all questions. This is a conservative approach as it decreases the number of patients reporting family-centeredness which may have made detecting an effect more difficult.

3.4 Characteristics of Interest

3.4.1 Primary predictor of interest

The primary characteristic of interest was the model of primary care service delivery. The model of primary care service delivery was a 4-level categorical variable, coded as community health center (CHC), fee-for-service practice (FFS), health service organization (HSO) or family health network (FHN) (Table 1).

3.4.2 Other predictors of interest

Other characteristics of interest were measured at the practice-level, provider-level and patient-level. Practice-level characteristics were of interest as potential predictors for Objective 2. Provider-level and patient-level characteristics were of interest as potential confounders for both Objective 1 and Objective 2.

3.4.2.1 Practice-level characteristics

Practice-level variables are summarized in Table 1. All practice-level variables were derived from the practice survey with the exception of after-hours telephone access. After-hours

telephone access was reported in the provider survey as a Likert response to the question "Outside of normal working hours does your practice have a telephone number (other than Tele health Ontario) that patients can call if they are sick?" Answers ranged from "Definitely" to "Definitely Not". "Not Sure/Don't Know" answers were considered missing responses. There were relatively few answers in the "Probably" and "Probably Not" categories (4.9 and 4.6 % of all responses respectively). After visually examining the distribution of responses it was apparent that in nearly all practices all providers would give the same response to this question, indicating that there was almost no variance in responses within practices and, for ease of interpretation, this could be considered a practice level variable. A practice was classified as having after-hours telephone access if the majority of providers reported that they definitely, or probably, had after-hours telephone access.

Table 1: Practice-level variables used in this thesis.

	Survey	Data Type	Responses	Notes
Practice-level				
Model of Service Delivery	Practice	Categorical	CHC FFS FHN HSO	
Panel size	Practice	Continuous		Mean number of patients per FTE family physician working at the practice (x 1000)
# years clinic has been operating	Practice	Continuous		
# clinical services available on site	Practice	Count	0 - 16	Which of the following services were available: Nutrition counseling by a nutrition specialist or dietitian, Family planning or birth control services, Alcohol or drug abuse counseling or treatment (20 min sessions or more), Counseling for behavioural or mental health problems, Suturing for a minor laceration, Allergy shots, Wart treatment, PAP smears, Sigmoidoscopy, Prenatal care, Preparation for delivery and delivery (off site) of babies, Splinting for a sprained ankle, Removal of an ingrown toenail, ECG/EKG (Electrocardiogram), Spirometry or Other.
# Family Physicians (FTE)	Practice	Continuous		FTE = Full-time equivalent
# Nurse Practitioners (FTE)	Practice	Continuous		FTE = Full-time equivalent
# Nurses (FTE)	Practice	Continuous		Due to small numbers in each group, registered nurses, registered practical nurses and nursing assistants were all grouped as “nurses”. (FTE = Full-time equivalent)
# Nurses (FTE) per Family Physician	Practice	Continuous		Calculated based on the number of FTE nurses and physicians reported
Setting				
Rurality index	Practice	Continuous		Based on the postal code of the practice. Assigned by Statistics Canada to particular areas based on a number of items including socioeconomic factors and isolation.
Electronic Medical Records	Practice	Categorical	Yes No	Based on the question “Has your practice, to any extent, implemented electronic patient health records”

Table 1: Continued

	Survey	Data Type	Responses	Notes
Practice-level				
Group practices	Practice	Categorical	Yes No	Considered a group if at least 4 of the 5 following resources were shared: office space, staff, expenses, patient records and on call duties[35].
After-hours telephone access	Provider	Categorical	Yes No	See section 3.4.2.1 for details

3.4.2.2 Provider level

Provider-level variables are summarized in Table 2. Please note, the number of years since graduation was calculated based on the year 2007 as done for the original study.

Table 2: Provider-level variables used in this thesis

	Survey	Data Type	Responses	Notes
Provider-level				
Years since graduation	Provider	Continuous		Calculated based on the reported year of graduation from medical or nursing school
Booking interval for routine visit (min)	Provider	Continuous		
Sex	Provider	Categorical	Male Female	

3.4.2.3 Patient level

Patient-level variables are summarized in Table 3. All patient level variables were derived from responses in the patient survey. Categorization of the following variables was consistent with the original study: Ethnicity, Education, Years Attending the Practice, Household Income.

Table 3: Patient-level variables used in this thesis.

	Survey	Data Type	Responses	Notes
Patient-level				
Age	Patient	Continuous		
Sex	Patient	Categorical	Male Female	
Ethnicity	Patient	Categorical	White Non-white	Original question had 13 categories. Categories were collapsed due to > 90% of respondents indicating they were white.
Education	Patient	Categorical	> High School High School or less	Original question had 9 categories (No Schooling; Some elementary or completed elementary school (Grade 6); Some high school; Completed high school; Some trade, technical or vocational school, or business college, community college, CEGEP, nursing school or university; Completed trade, technical or vocational school, business college, community college, CEGEP or nursing school; Completed University/Graduate school; Other; Do not wish to answer)
Chronic Condition	Patient	Categorical	Yes No	If they reported having ever been diagnosed with any of the following: hypertension, angina pectoris or coronary artery disease, congestive heart failure, a myocardial infarction or heart attack, stroke, asthma, emphysema or COPD (chronic obstructive pulmonary disease), diabetes, arthritis or any kind of rheumatism, chronic back pain or sciatica, depression, chronic heart burn or ulcers¸ any cancer (other than skin cancer)
Years attending practice	Patient	Categorical	> 5 years < 5 years	Original question had 5 categories (< 6 months, 6 months – 1 yr, 1-2 yrs, 3-4 years, 5 < yrs). Categories were collapsed due to > 70% of respondents indicating they had been with the practice > 5 years.

Table 3: Continued

	Survey	Data Type	Responses	Notes
Patient-level				
Household Income (annual)	Patient	Categorical	> LICO < LICO	Original question had 10 categories (< $5,000, $5,000 – 9,999, $10,000 – 14,999, $15,000 – 24,999, $25,000 – 34,999, $35,000 – 49,999, $50,000 – 64,999, $65,000 – 79,999, $80,000 or more, Do not wish to answer). For consistency with the original study, this variable was converted to a binary variable indicating above or below LICO (Low Income Cut Off, a measure of household deprivation used by Statistics Canada[36]).
# family members attending clinic	Patient	Continuous		

3.5 Statistical Analysis

3.5.1 Descriptive Analysis

Normality of the distribution of continuous variables at all levels (practice, provider and patient level) was examined by visual inspection of histograms. Continuous variables were found to be approximately normally distributed and were described across models using means with standard deviations. Categorical variables at all levels were described across models using frequencies and percentages.

3.5.2 Regression Models and Clustering

The clustering of providers and patients within practices requires consideration when performing statistical analyses as the violation of the assumption of independent observations may lead to underestimates of standard errors, overly narrow confidence intervals and an increased probability of a Type I error[37,38]. Two different methods of accounting for the clustering of observations were used in this thesis as the provider-reported outcome was continuous, while the patient-reported outcome was dichotomous:

1) provider-level analyses were carried out using linear mixed regression models, estimated by means of Restricted Maximum Likelihood Estimation with the practice specified as a random effect and all other predictors specified as fixed effects, 2) patient-level analyses were carried out using Generalised Estimating Equations (GEE). When models are fit with variables at different levels (e.g.: provider level outcome with patient and/or provider and/or practice level predictor variables) they are generically called multi-level models as, in the hierarchical nature of clustered data where observations fall within clusters, they allow the assessment of relationships between different levels of data[39]. All confidence intervals and p-values for provider- and patient-level analyses therefore account for clustering within practices. As recommended, Kenward-Roger adjustment to degrees of freedom was used throughout the analysis when specifying linear mixed models[40]. Model-based standard errors were used when evaluating the significance of the regression coefficients in all GEE models. While empirical standard errors are often used in GEE because they are robust to misspecification of the correlation matrix, this is an asymptotic property which may not be valid in this study where there are 32-35 practices (or clusters) per model of primary care service delivery (or arm of the trial) and a large number of predictor variables. Furthermore, since the data are not longitudinal, we can be fairly confident in the model-based specification of the covariance structure as exchangeable (constant).

All models were fit using a commercially available software program, SAS 9.2[41] using the MIXED and GENMOD procedures.

3.5.3 Bivariable Analysis

Bivariable analysis is used here to refer to the examination of the relationship between characteristics of interest at the practice, provider and patient level, and three variables a) the model of primary care service delivery, b) the provider-reported FCC score, and c) the dichotomous patient-reported FCC. Bivariable analyses were performed in order to better understand the data, given the lack of previous research in the field, and to identify potential confounders for the multivariable models.

3.5.3.1 Association with model of primary care service delivery

Practice level

The bivariable associations between continuous practice-level variables and the model of primary care service delivery were tested using simple linear regression models with each practice-level characteristic as dependent variable and the model of service delivery as a 4-level categorical predictor variable. The associations between categorical practice-level variables and the model of primary care service delivery were tested using chi-squared tests.

Provider-level

The bivariable association between continuous provider-level variables and the model of primary care service delivery was tested using linear mixed models with the dependent variable specified as the provider-level variable and the independent variable the model of primary care service delivery. The association between the categorical provider-level variable (i.e., sex) and the model of primary care service delivery was tested using marginal logistic regression with GEE where sex was the dependent variable and the model or primary care service delivery was specified as the independent variable.

Patient-level

The bivariable association between continuous patient-level variables and the model of primary care service delivery was tested using linear mixed models with the dependent variable specified as the patient-level variable and the independent variable the model of primary care service delivery. The association between categorical patient-level variables and the model of primary care service delivery was tested using marginal logistic regression models with GEE where the dependent variable was specified as the patient-level variable and the model of primary care service delivery specified as the independent variable.

3.5.3.2 Association with provider-reported FCC

Practice Level

Visual examination of scatterplots of continuous practice-level variables and provider-reported FCC scores was carried out to identify trends. The bivariable association of provider-reported FCC scores with each of the continuous and categorical practice-level variables was tested using linear mixed models, with provider-reported FCC scores as dependent variable, and the practice-level variables entered as independent variables. Practice was specified as a random effect.

Provider- Level

Visual examination of scatterplots of continuous provider-level variables and provider-reported FCC scores was carried out to identify trends. The bivariable association between continuous and categorical provider-level variables and provider-reported FCC scores was tested using linear mixed models with the dependent variable specified as the provider-

reported FCC score and the other provider-level variable specified as a fixed effect. Practice was specified as a random effect.

Patient Level

As there was no way of linking patients to their respective providers, patient-level variables were aggregated at the practice level when looking at their bivariable relationship with provider-reported FCC. The mean response within a practice was used for continuous variables. The proportion of patients giving a response was used for categorical variables. Regression modeling was carried out as for practice-level variables.

3.5.3.3 Association with patient-reported FCC

Practice-level

Visual examination of estimated logit plots for patient-reported FCC was carried out to assess associations with categorical practice-level variables. Continuous practice-level variables were categorized and then visual examination of logit plots was carried out as for categorical variables. The bivariable association between all practice-level variables and patient-reported FCC was tested with marginal logistic regression models using GEE with the dependent variable specified as the patient-reported FCC and the independent variable the practice-level variables.

Provider-level

As there was no way of linking providers to their respective patients, provider-level variables were aggregated at the practice level when looking at their bivariable relationship with patient-reported FCC. The mean response within a practice was used for continuous variables while the proportion of the practice giving a specific response was used for categorical variables. Aggregated variables were categorized and visual examination of

estimated logit plots for patient-reported FCC was carried out to assess trends. Marginal logistic regression modeling was carried out using GEE with the dependent variable specified as the patient-reported FCC and the independent variable the provider-level responses aggregated to the practice-level.

Patient-level

Visual examination of the estimated logit plots for patient-reported FCC of categorical patient-level variables was carried out to assess trends. Continuous patient-level variables were categorized and then visual examination of logit plots was carried out as for categorical variables. The bivariable association between all patient-level variables and patient-reported FCC was tested using marginal logistic regression models with GEE where the dependent variable was specified as the patient-reported FCC and the independent variable the other patient-level response.

3.5.4 Multivariable Analysis

3.5.4.1 Confounder Selection

Since certain patient-level characteristics vary by practice type, e.g.: CHCs serve significantly more immigrants and lower income patients than other models[42], it was important to check for potential confounding by these factors. If these characteristics were also associated with family-centered care then failing to adjust for them may have attenuated or exaggerated the relationship between family-centered care and the model of primary care service delivery. A secondary analysis was also done to control for provider-level characteristics as potential confounders. There is some debate over the utility of this comparison as some argue that provider factors are in fact characteristics of the delivery

models (ex: >70% of providers in CHC practices are female, compared to 26-44% in the other models) while others consider them confounding factors. Final models both with and without adjustment for provider factors were built.

In selecting confounders, several different approaches were considered. Mickey and Greenland tested several rules for confounder selection and cautioned against the use of significance testing when defining confounders, recommending instead the use of a percent change in the parameter estimate as the rule to decide on confounding[43]. While the percent change rule is intuitive and was most successful at correctly identifying confounders in their study, the nature of our modeling, where the primary predictor was a 4 level categorical variable, meant that there was not a single parameter to test for change and the rule was therefore not applicable. If using significance testing to identify confounders, Mickey and Greenland cautioned that the main problem was that the results biased the choice towards the crude analysis and therefore recommended choosing a significance level of at least 0.20 to minimize this bias[43]. Furthermore, they recommended testing either the association between the outcome and the potential confounder or between the predictor and the potential confounder, rather than testing both, as testing both associations biased the selection towards the crude analysis. However, this recommendation is not in keeping with the theoretical definition of a confounder as a covariate related to both the exposure and the outcome. Furthermore, Brookhart et al state that controlling for a variable that has a strong association with an exposure and no association with the outcome can increase the variance and bias the exposure effect in statistical modelling[44]. In order to minimize this bias and also take the recommendation of Mickey and Greenland to use a fairly high significance level when employing significance testing in choosing confounders[43], in this thesis a variable was

considered a confounder if it was associated with both the exposure (model of service delivery) and the outcome (provider- or patient-reported FCC) at a significance level of 0.20.

3.5.4.2 Missing Data Analysis

With any survey there is the possibility that participants will choose not to answer certain questions resulting in missing data points. This is of concern since observations with a missing value will be dropped from the statistical analysis, which is of particular concern if the data are not missing completely at random. Under the assumption of Missing Completely At Random (MCAR), those who failed to answer a question are assumed to be a random subsample of all subjects and therefore, do not differ from those who did answer all questions. If the MCAR assumption is satisfied, an analysis based on only the observed data would yield unbiased estimates in the analysis. Under the assumption of Missing At Random (MAR), subjects with missing values differ from subjects with non-missing values, but the differences are observed and can therefore be adjusted for in the analysis. For example those with lower education may have difficulty understanding some of the questions and therefore answer fewer of them; however, if educational attainment is known and adjusted for in the analysis, unbiased estimates may be obtained. The worst case scenario is Missing Not at Random (MNAR), where subjects with missing values are different from subjects with non-missing values, but these differences cannot be adjusted for in the analysis as they are based on the unknown missing values themselves. For example, subjects with lower family centeredness scores (the outcome of interest) may be less likely to provide complete data. Under MNAR, analyses using the observed data only will be biased. Accounting for MNAR would require a specification of the missing data mechanism

which usually involves untestable assumptions about the distributions for the missing data. However, under the assumption of MAR, standard regression analyses can be used, as long as the variables associated with missingness are accounted for in the analysis[45,46]. In this thesis, we assumed MAR throughout. To determine whether any of the predictor variables were associated with missing data, bivariable regression models using GEE were fit with the dependent variable being whether or not a data point was missing. To account for any potential bias due to missing data, any variables that were significantly associated with missingness were forced in to the multivariable models for all outcomes, regardless of their statistical significance.[85] For predictor variables with a large proportion of missing values, one approach would have been to exclude these predictors from the list of candidate predictors, as subjects with missing values on any predictor would automatically be excluded from a stepwise regression analysis, regardless of whether or not that variable is selected in the final step. An alternative approach would have been multiple imputation[47]. However, as multiple imputation methodology has not yet been fully developed for clustered data, and generating imputations without accounting for clustering may lead to biased standard errors, we decided to conduct a sensitivity analysis to determine whether removing such predictors from the model substantially changed the results.

3.5.4.3 Objective 1

To address the first objective of this thesis, namely to determine whether models of primary care service delivery differ in their provision of family-centered care, the inferential goal was to evaluate the model of care delivery as a predictor of family-centeredness while adjusting for factors that could potentially confound this relationship. Three different

statistical models of provider-reported family centeredness were tested: **Model 1.A** was fit in order to test the crude association between model of primary care service delivery and provider-reported FCC using linear mixed modeling; **Model 1.B** was the first adjusted model and included all aggregated patient level variables considered potential confounders. Before adjusting for potential confounders, all potential aggregated patient-level confounders identified according to the criteria set out previously were tested for collinearity using Pearson correlation coefficients. **Model 1.C**, the second adjusted model, included both patient and provider level confounders. When a significant association with models of primary care service delivery was identified, pairwise comparisons between model types were made to identify significant differences. All pairwise comparisons were adjusted for multiple testing using Tukey's method. Mean family-centeredness scores, and 95% confidence intervals, for each model of primary care service delivery were estimated from Model 1.A-C.

Similarly, three different statistical models of patient-reported family centeredness were tested. **Model 2.A** was fit in order to test the crude association between model of primary care service delivery and patient-reported FCC using marginal logistic regression with GEE. **Model 2.B** was the first adjusted model and included all patient-level variables considered potential confounders. Before adjusting for potential confounders, all continuous patient-level characteristics identified as potential confounders according to the criteria set out previously were tested for collinearity using Pearson correlation coefficients. **Model 2.C**, the second adjusted model, included both patient and provider level confounders. The odds ratios for patient-reported family-centeredness, and 95% confidence intervals, for each model of primary care service delivery were estimated from Model 2.A-C.

3.5.4.4 Objective 2

To address the second objective of this thesis, to identify organizational characteristics of primary care practices associated with family-centered care, the inferential goal was to create the most parsimonious model to identify organizational characteristics that were independent predictors of family-centeredness.

Similar analytical methods as described for the first objective (see 3.5.4.3) were used to identify organizational characteristics associated with family-centeredness. A stepwise backward elimination procedure was used and all practice-level predictors significant at the 10% level were retained in the model.

In addressing the second objective, organizational characteristics (i.e.: practice-level characteristics) will constitute the primary predictors of family-centeredness. The model of primary care service delivery was specifically excluded as a predictor since the objective was to determine which organizational characteristics are associated with family-centered care irrespective of the service delivery model. Once the final regression model was determined, the model of care delivery was included in order to determine if any residual effect of the model of service delivery remained after accounting for specific organizational characteristics. Adjustment was made for confounding by patient and provider characteristics identified as confounders in the first objective.

Variables considered in the multivariable regression models were centered so that the intercept for the regression model could be interpreted as the adjusted mean estimate for the average provider (or patient)[48].

Chapter 4: Results

4.1 Participants

137 practices participated in the original study (35 FFS, 35 CHC, 35 FHN and 32 HSO). The overall practice recruitment rate was 45% and was lowest in the FFS stratum (23%) where 35, out of the random sample of 151 eligible practices approached, agreed to participate (Table 4). Since all CHC, FHN and HSO practices in the province were approached, the provincial recruitment rates for each model type were 69% (35/51 practices), 37% (35/94 practices), and 49% (32/65 practices) respectively. The sample of practices recruited into the original study was broadly representative of all Ontario family physicians in equivalent models for all demographic and billing parameters measured[10]. Within these practices 363 providers and 5,361 of their patients also participated (Table 4). CHCs had the highest average number of providers per practice (cluster size) while HSOs had the lowest (Table 5). The average number of patients per practice (cluster size) was lowest in CHCs and was fairly similar across the other three model types (Table 5).

The sample of participants from the original study that were used for this thesis were included based on the criteria described in section 3.3 (those who answered >50% of the FCC scale items). 100% of the providers from the original study (n = 363) and 96% of the patients from the original study (n = 5,144) were included in this analysis (Table 4).

Table 4: Study participation rate, including participation in the original study and for this thesis. Adapted from Dahrouge et al[10].

	CHC	HSO	FHN	FFS	Overall
Practices					
Approached, n	53	69	104	197	423
Eligible, n	51	65	94	155	365
Participated, n	35	32	35	35	137
Participation rate, %	69	49	37	23	45
Providers					
Participated,* n	182	42	81	58	363
Included in thesis, n	182	42	81	58	363
Included in thesis, % of participants	100	100	100	100	100
Patients					
Invited to participate, n	1591	1590	1583	1758	6522
Participated, n	1219	1273	1494	1375	5361
Response rate, %	77	80	94	78	82
Included in thesis, n	1159	1213	1442	1330	5144
Included in thesis, % of participants	95	95	97	97	96

CHC = community health centre, HSO = health service organization

FHN = family health network, FFS = traditional fee-for-service and family health group.

*Provider recruitment was relinquished to the practice manager. We did not track the actual participation rate other than to ensure it was at least 50%.

Table 5: Measures of cluster size.

	CHC	HSO	FHN	FFS	Overall
Practices, no.	35	32	35	35	137
Providers (per practice)					
Mean	5.2	1.3	2.3	1.7	2.7
Minimum	1	1	1	1	1
Maximum	9	5	9	5	9
Patients (per practice)					
Mean	33	38	41	38	38
Minimum	16	29	28	26	16
Maximum	53	50	50	52	53

4.2 Bivariable Associations with Model type

4.2.2 Practice Level

Means with standard deviations for continuous practice-level variables and frequencies and proportions for the categorical variables are shown by model of primary care service delivery in Table 6. All practice-level variables except Rurality Index varied significantly by model of primary care service delivery ($p < 0.05$; Table 6). CHCs had more nurse practitioners (2.5 vs. 0.3 or fewer) and other nurses (2.7 vs. 0.6 – 2.0) on staff, and, along with FHNs, had a greater number of family physicians (3.0 and 3.6 vs. 2.4 and 1.7) when compared to the other models of primary care service delivery. CHCs also had the highest proportion of practices with after-hours telephone access (91% vs. 73% or less) and the highest number of clinical services available on site (11.3 vs. 9.3 – 9.7). FHN and HSO practices had been in operation the longest (24 and 27 years vs. 16 and 18 years) and had the highest proportion of practices with electronic medical records (45 and 59%). FFS practices had the lowest proportion of practices with electronic medical records (15%).

Table 6: Profile distribution of practice-level characteristics by model of primary care service delivery.

	Profile Distribution				
	CHC	FFS	FHN	HSO	
Practice Characteristics n	**35**	**35**	**35**	**32**	
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**p value**
Panel size[a]	1.3 (0.8)	1.8 (1.0)	1.5 (0.8)	2.0 (1.2)	0.033
Years clinic has been operating	18.3 (7.6)	16.4 (9.3)	24.4 (10.6)	26.7 (9.5)	< 0.0001
# Clinical services available on site	11.3 (2.0)	9.5 (2.6)	9.7 (2.9)	9.3 (2.3)	0.0036
# Family Physicians (FTE)	3.0 (1.1)	2.4 (1.8)	3.6 (3.3)	1.7 (1.2)	0.0017
# Nurse Practitioners (FTE)	2.5 (1.4)	0.1 (0.3)	0.3 (0.5)	0.2 (0.4)	< 0.0001
# Nurses (FTE[b])	2.7 (1.9)	0.6 (1.0)	2.0 (2.1)	1.1 (0.9)	< 0.0001
Nurses (FTE[b]) per Family Physician	0.9 (0.6)	0.2 (0.3)	0.6 (0.6)	0.7 (0.6)	< 0.0001
Setting					
Rurality index	14.0 (18.9)	12.6 (17.6)	16.2 (18.7)	8.0 (9.2)	0.234
	n (%)	**n (%)**	**n (%)**	**n (%)**	
Electronic Medical Records	10 (29.4)	5 (14.7)	20 (58.8)	14 (45.2)	0.0012
Group practices	35 (100)	26 (74.3)	22 (62.9)	20 (62.5)	0.0006
After-hours telephone access	31 (91.2)	19 (57.6)	22 (62.9)	22 (73.3)	0.013

[a] panel size is the mean number of patients per FTE family physician (X 1000)

[b] refers to full time equivalent (FTE) nurses, registered practical nurses and nursing assistants

4.2.3 Provider Level

Means with standard deviations for continuous provider-level variables and frequency and proportion for the categorical variable are shown by model of primary care service delivery in Table 7. Particularly notable is the longer average booking interval and higher proportion of female providers at CHCs. Also, the proportion of female providers was much lower and

the average number of years since graduation was much higher in HSOs than in the other model types.

Table 7: Profile distribution of provider-level characteristics by model of primary care service delivery.

	Profile Distribution				
	CHC	FFS	FHN	HSO	
Provider Characteristics n	**182**	**58**	**81**	**42**	
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**p value***
Years since graduation	20.0 (9.9)	23.3 (8.9)	23.6 (9.2)	29.5 (9.6)	< 0.0001
Booking interval for routine visit (min)	24.8 (6.2)	12.9 (3.0)	13.9 (4.5)	13.6 (3.1)	< 0.0001
	n (%)	**n (%)**	**n (%)**	**n (%)**	
Sex (Female)	131 (72.8)	26 (44.8)	33 (40.7)	11 (26.2)	< 0.0001

*all p-values are adjusted for clustering of providers by practice.

4.2.4 Patient Level

Frequencies and proportions for categorical variables and means with standard deviations for continuous patient-level variables are shown by model of primary care service delivery in Table 8. Patients in this study were more likely to be middle-aged white females, have a chronic condition, have more than high school education, have fairly high household incomes and have attended their practice for more than 5 years. Notable trends show that patients at CHCs were younger ($p = 0.0003$), less educated ($p = 0.18$), had lower household incomes ($p < 0.0001$), were less likely to be white ($p = 0.0002$) and had been attending the practice for shorter times ($p < 0.0001$) than patients in other models.

Table 8: Profile distribution of patient-level characteristics by model of primary care service delivery.

	Profile Distribution				
	CHC	FFS	FHN	HSO	
Patient Characteristics n	**1159**	**1330**	**1442**	**1213**	
	n (%)	**n (%)**	**n (%)**	**n (%)**	**p value***
Sex (Female)	839 (73.2)	887 (67.3)	942 (65.9)	729 (60.7)	0.0002
Ethnicity (White)	884 (81.6)	1142 (88.4)	1357 (95.0)	1148 (95.2)	0.0002
Education (> High School)	671 (60.6)	851 (66.0)	919 (65.5)	772 (65.4)	0.18
Chronic Condition	840 (74.0)	956 (72.3)	1072 75.6)	872 (72.5)	0.46
Years Attending this Practice					< 0.0001
< 0.5 yrs	92 (8.1)	50 (3.9)	35 (2.5)	13 (1.1)	-
0.5 - 1 yrs	80 (7.0)	45 (3.5)	38 (2.7)	15 (1.2)	-
1 - 2 yrs	146 (12.8)	131 (10.1)	120 (8.5)	42 (3.6)	-
3 - 4 yrs	163 (14.3)	171 (13.2)	158 (11.2)	85 (7.2)	-
5 or more yrs	656 (57.7)	898 (69.3)	1055 (75.0)	1026 (86.9)	-
Household Income (> LICO)	575 (66.2)	913 (87.4)	1023 (88.6)	849 (88.4)	< 0.0001
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	
Age	46.5 (16.9)	49.9 (16.4)	51.3 (16.5)	51.1 (17.2)	0.0003
# Household members attending clinic	1.4 (1.5)	1.4 (1.4)	1.4 (1.4)	1.7 (1.5)	0.028

*all p-values are adjusted for clustering of patients by practice.

4.3 Bivariable Associations with Provider-Reported Family-centeredness

4.3.1 Provider-Reported Family-centeredness

Provider-reported FCC scores ranged from 0.55 to 1.0 across the whole population and were negatively skewed (Figure 4). Based on visual inspection, scores appeared to be slightly higher in CHCs where the mean score was 0.89 compared to 0.82 - 0.84 in the other model types (Figure 5).

Figure 4: Histogram of the distribution of provider-reported FCC scores with superimposed normal distribution.

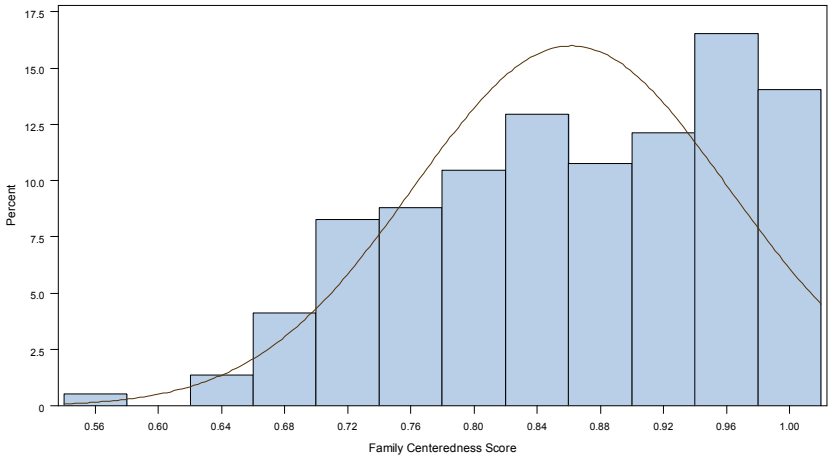
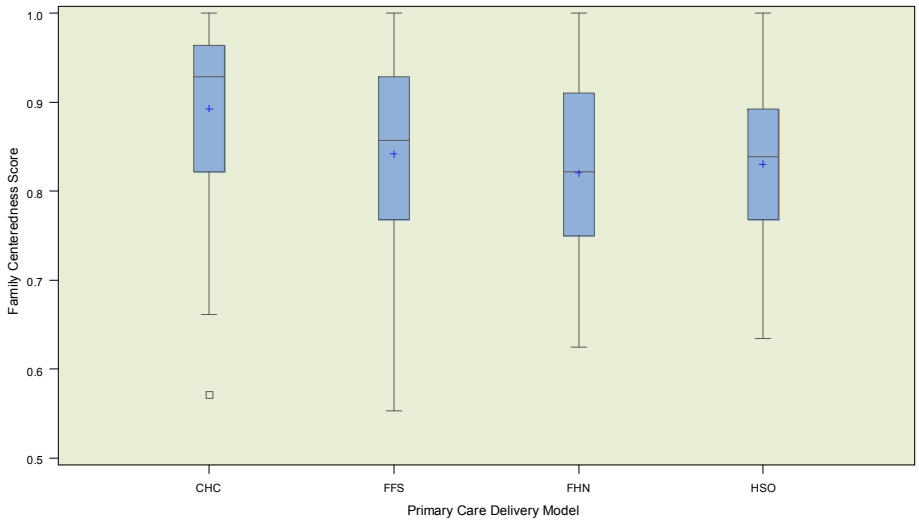


Figure 5: Box plot showing the distribution of provider-reported FCC score by primary care service delivery model; the plus sign represents the mean, the center line shows the median, box covers 25th-75th percentile of scores, lines show range of scores.



Provider-reported FCC scores appeared to be higher when practices had after-hours telephone access and when they were group rather than solo practices (Figure 6). Scores may also be slightly higher in practices where electronic medical records are used, however the very large standard deviations associated with this distribution indicates that this is not likely to be an important difference (Figure 6).

Figure 7 shows the crude relationship between continuous practice-level characteristics and provider-reported FCC scores. Based on visual inspection of the scatterplots, linear and non-linear trends will be investigated by adding both linear and quadratic terms for each predictor to the bivariable model. If the quadratic term for a predictor is non-significant in the bivariable tests, only the linear term for that predictor will be retained in the final bivariable result and when assessing whether the variable should be in included in the multivariable result.

Figure 6: Mean provider-reported FCC scores associated with categorical practice-level variables. Error bars show standard deviation.

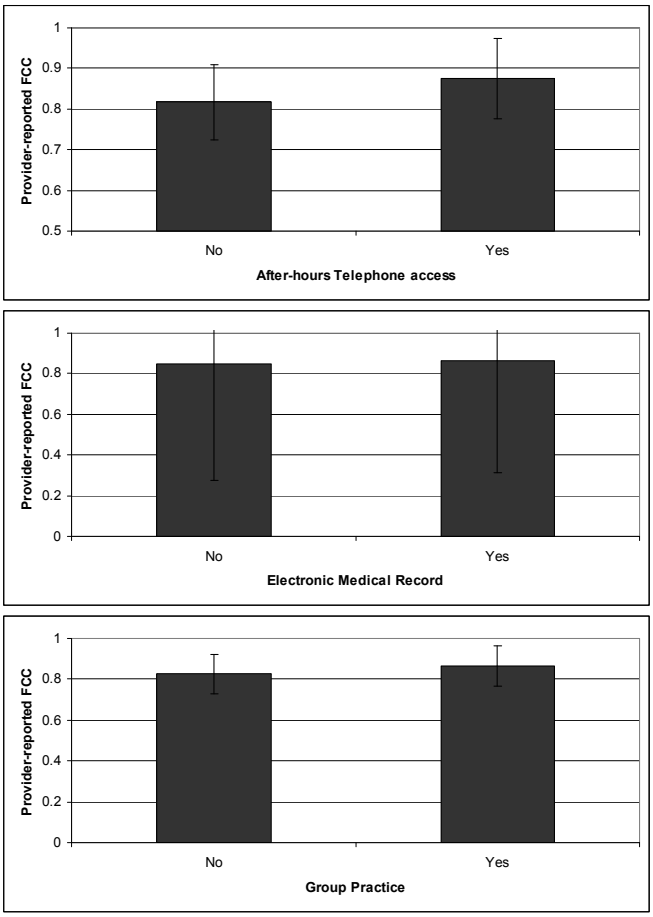


Figure 7: Scatterplots of provider-reported FCC scores and continuous practice-level variables showing trend lines.

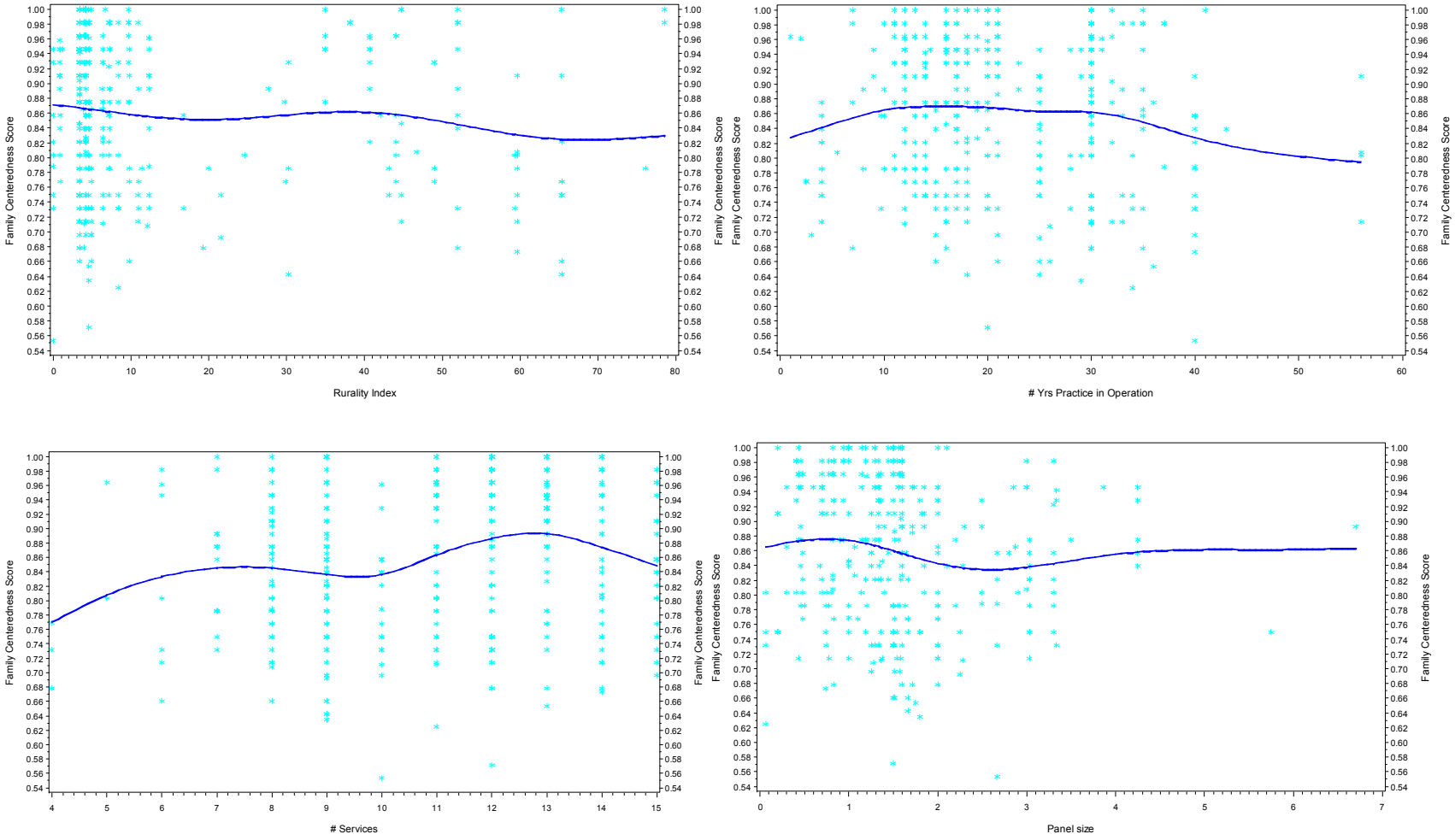
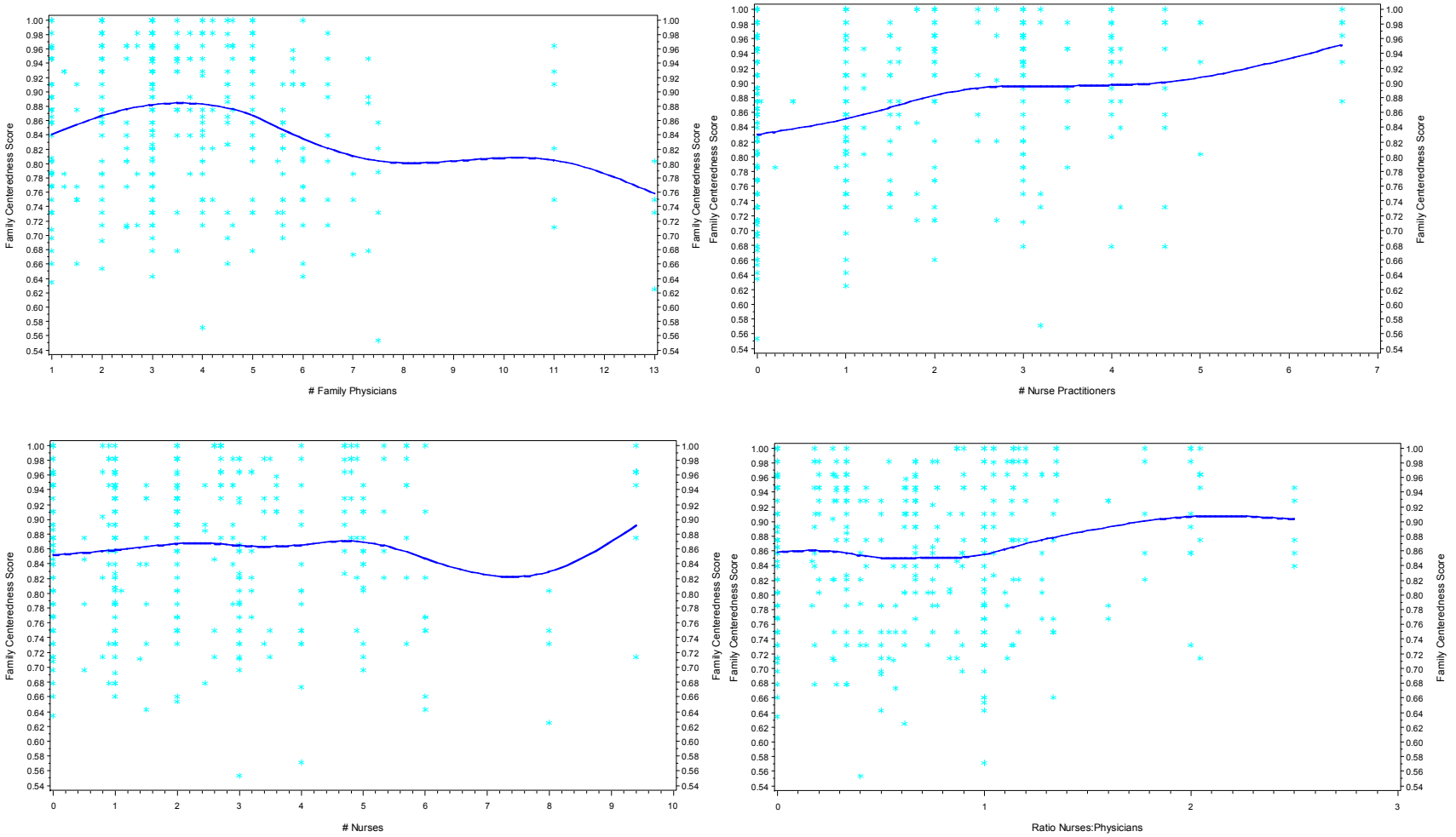


Figure 7: cont'd



4.3.2 Practice Level

There was a significant positive association between the number of services available on site and provider-reported FCC (Table 9). For each additional service available the average provider-reported FCC score increased by 0.7%.

Group practices tended to have higher FCC scores than solo practices (0.86 vs. 0.83), however this association was not significant ($p = 0.07$; Table 9). This may be due to a differing effect between models, in FHNs providers in group practices reported lower average FCC scores than those in solo practices which is the opposite relationship of what is observed in the other three model types.

There was a significant association between having after-hours telephone access and provider-reported FCC (Table 9). FCC scores were on average 4.9% higher when a practice had after-hours telephone access.

Provider-reported FCC showed a significant quadratic relationship with the number of FTE family physicians (Table 9). Provider-reported FCC peaked when there were 4 FTE family physicians in the practice.

Provider-reported FCC was positively associated with the number of FTE nurse practitioners in a practice (Table 9). For each additional FTE nurse practitioner the average FCC score increased by 1.8 %.

There was no significant association found between provider-reported FCC and the ratio of nurses to physicians ($p = 0.2751$).

Table 9: Bivariable association between provider-reported FCC and characteristics of interest

	Estimated Regression Coefficients		
	Mean increase in the FCC score associated with a unit increase in the predictor		
	β	**[95% CI]**	**p value**
Practice characteristics			
Model of Service Delivery			
CHC	0.061	[0.026 - 0.096]	0.0008
FFS	0.014	[-0.026 - 0.054]	0.49
FHN	-0.006	[-0.04 - 0.03]	0.77
HSO	(reference)	-	-
Panel size[a]	-0.006	[-0.02 - 0.009]	0.42
# years clinic has been operating	-0.0006	[-0.002 - 0.0007]	0.35
# clinical services available on site	0.007	[0.0015 - 0.012]	0.012
Family Physicians (FTE)* - quadratic	-0.0016	[-0.003 - -0.0002]	0.027
Family Physicians (FTE)* - linear	0.0012	[-0.006 - 0.008]	0.11
Nurse Practitioners (FTE)	0.018	[0.01 - 0.026]	<0.0001
Nurses (FTE[b])	0.001	[-0.005 - 0.008]	0.71
Nurses (FTE[b]) per Family Physician	0.012	[-0.01 - 0.035]	0.28
Electronic Medical Records	-0.011	[-0.039 - 0.016]	0.41
Group practices	0.033	[-0.003 - 0.07]	0.071
After-hours telephone access	0.049	[0.020 - 0.078]	0.001
Setting			
Rurality index	-0.0004	[-0.001 - 0.0003]	0.28
Provider Characteristics			
years since graduation	-0.0004	[-0.002 - 0.0007]	0.48
Booking interval for routine visit (min)	0.003	[0.001 - 0.004]	0.0014
Sex (Female)	0.034	[0.014 - 0.055]	0.0009
Patient Characteristics (Aggregated)			
Sex (10% Female)	0.012	[0.002 - 0.021]	0.019
Ethnicity (10% White)	-0.002	[-0.009 - 0.005]	0.58
Education (> High School) (10%)	0.005	[-0.005 - 0.014]	0.36
Chronic Condition (10%)	0.009	[-0.004 - 0.021]	0.16
Years attending practice (> 5 yrs) (10%)	-0.06	[-0.012 - 0.0005]	0.069
Household Income (> LICO) (10%)	-0.009	[-0.016 - -0.002]	0.018
Age	0.0005	[-0.003 - 0.002]	0.65
# family members attending clinic	-0.024	[-0.052 - 0.005]	0.099

[a] panel size is the mean number of patients per FTE family physician (X 1000)
[b] refers to full time equivalent (FTE) nurses, registered practical nurses and nursing assistants
* Since there is a quadratic relationship with the outcome, the predictor variable "Family Physicians (FTE)" is centered.

4.3.3 Provider Level

Provider's sex and booking interval for routine visits were positively associated with provider-reported FCC scores (Table 9). Provider-reported FCC scores were on average 3.4% higher for females than for males. Each 5 minute increase in booking interval was associated with an average increase of 1.5% in provider-reported FCC score. Based on the criteria outlined previously, the provider-level variables that will be considered potential confounders of provider-reported FCC are provider sex and booking interval for routine visits.

4.3.4 Patient Level

The proportion of female patients and the proportion of patients with a chronic condition in a given practice were both positively associated with provider-reported FCC scores (Table 9). For each 10 % increase of females in a practice the average provider-reported FCC increased by 1.2%. For each 10% increase in the proportion of patients with a chronic condition the average provider-reported FCC score increased by 0.9%; this increase was not statistically significant at the 5% level, but was within the significance cut-off to meet one of the criteria for being considered a confounder. However, since this variable did not meet the second criteria it was not considered a potential confounder. The proportion of patients with an annual household income above LICO, the proportion of patients attending the practice for more than 5 years, and the average number of household members attending the clinic were negatively associated with provider-reported FCC. For each 10% increase in the proportion of patients with an annual household income above LICO the average provider-reported FCC score decreased by 0.9% this association was significant at the 5% level. For each 10% increase in the

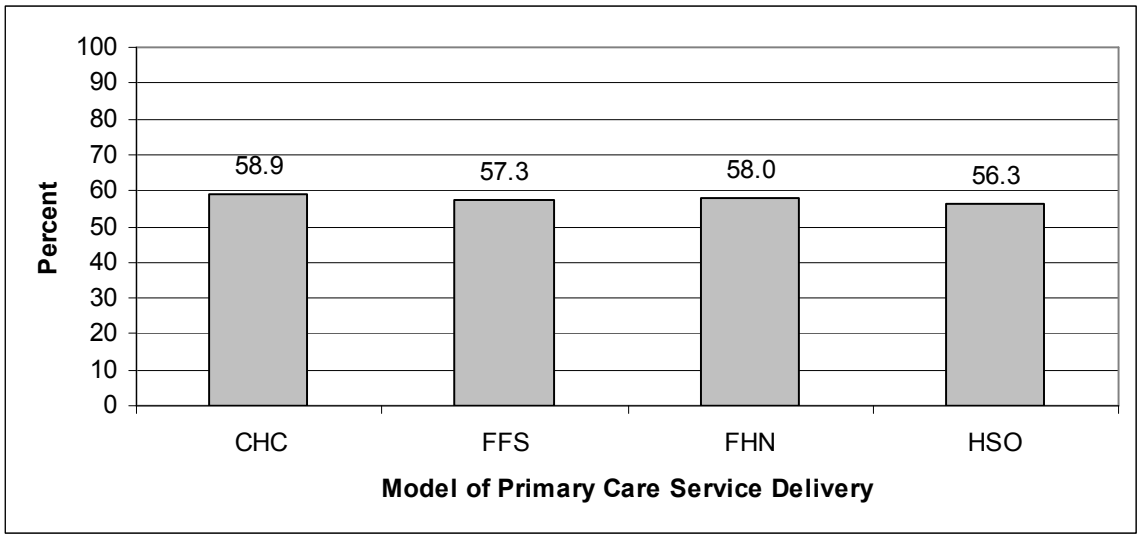
proportion of patients attending the practice for more than 5 years the average provider-reported FCC score decreased by 5.8%; this was not significant at the 5% level, however this variable was considered as a confounder according to the criteria outlined previously. A one person increase in the average number of household members attending the clinic was associated with a decrease of 2.4 % in the average provider-reported FCC score; this was not significant at the 5% level, however this variable was considered as a confounder according to the criteria outlined previously.

4.4 Bivariable Associations with Patient-Reported Family-centeredness

4.4.1 Patient-Reported Family-centeredness

Overall, 58 % (2,965/5,144) of the included patients reported receiving family-centered care while 43% (2,179/5,144) reported that they did not receive family-centered care. The proportion of patients reporting FCC did not appear to differ substantially between models, ranging from 56.3 % (683/1,213) of HSO patients to 58.9% (683/1,159) of CHC patients (Figure 8).

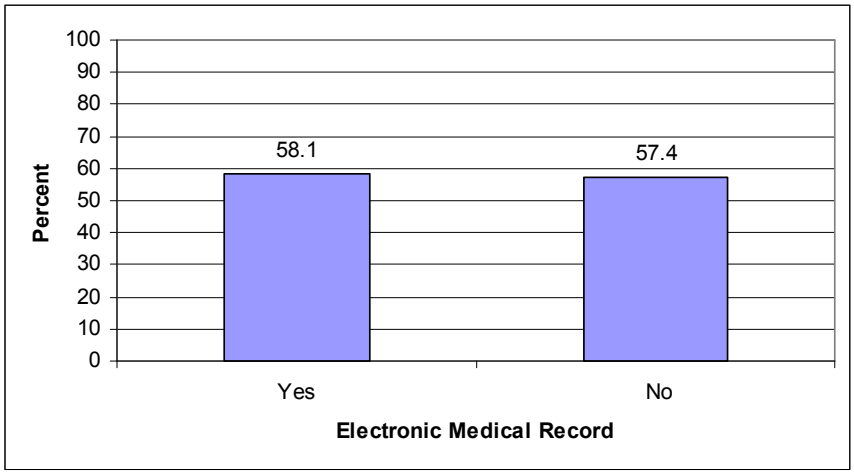
Figure 8: Proportion of patients reporting family-centered care by model.

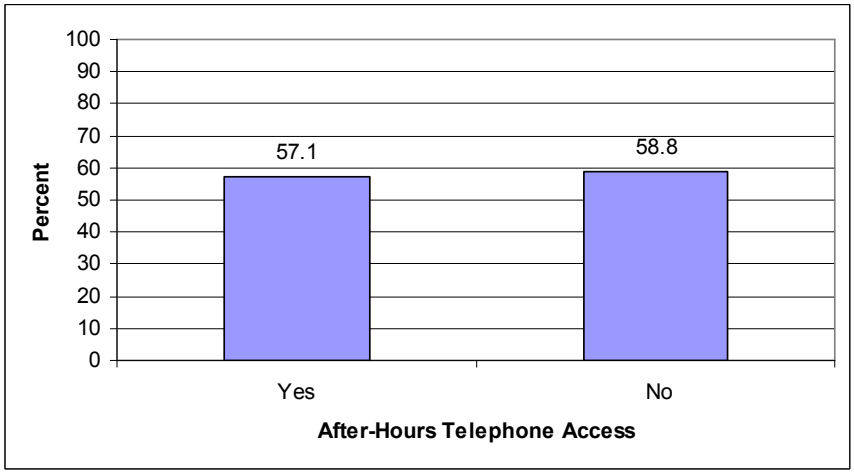


The proportion of patients reporting FCC did not appear to differ based on whether a practice had after-hours telephone access, was a group rather than a solo practice or had electronic medical records (Figure 9).

Figure 10 shows the relationship between the estimated logit of patient-reported FCC and the remaining practice-level characteristics. Based on visual inspection of the logit plots, linear and non-linear trends will be investigated. Rurality Index appears to have a positive relationship with the logit of patient-reported FCC. The number of nurse practitioners appears to show a cubic relationship with the logit of patient-reported FCC**.** The number of years a clinic has been in operation and the ratio of nurses to physicians may have cubic relationships with the logit of patient-reported FCC. Panel size and the number of full time physicians appear to be negatively related to the logit of patient-reported FCC.

Figure 9: Proportion of patients reporting family-centered care by dichotomous practice level variables.





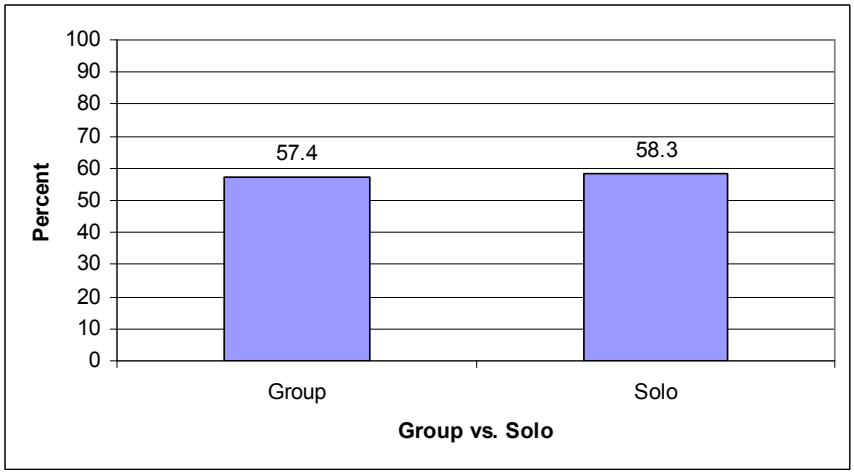
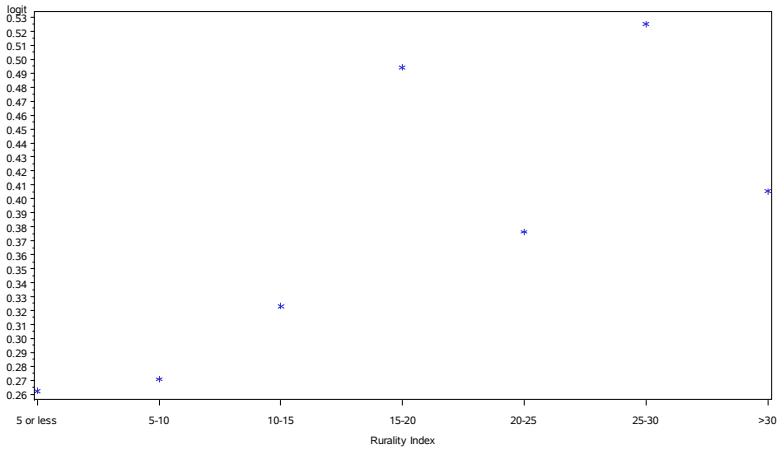
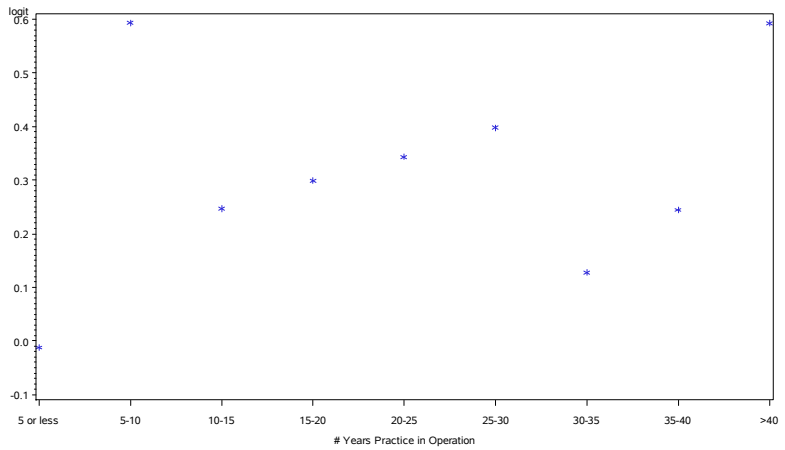
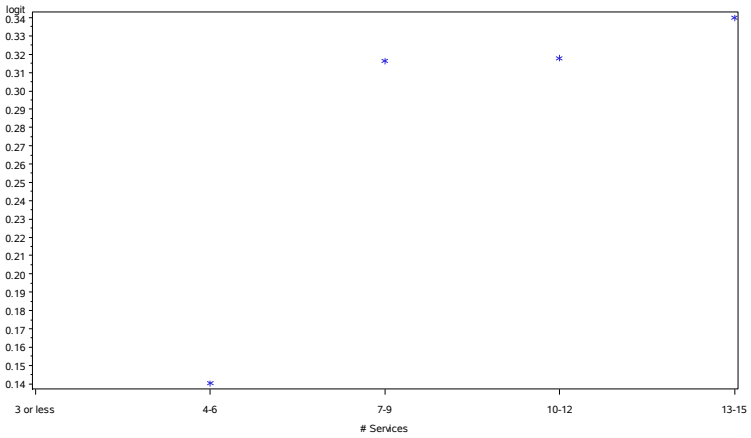


Figure 10: Estimated logit plots of non-dichotomous practice-level variables.







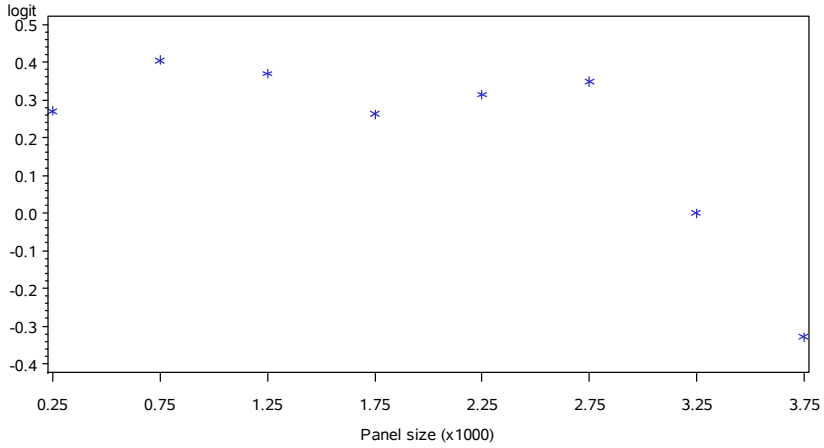
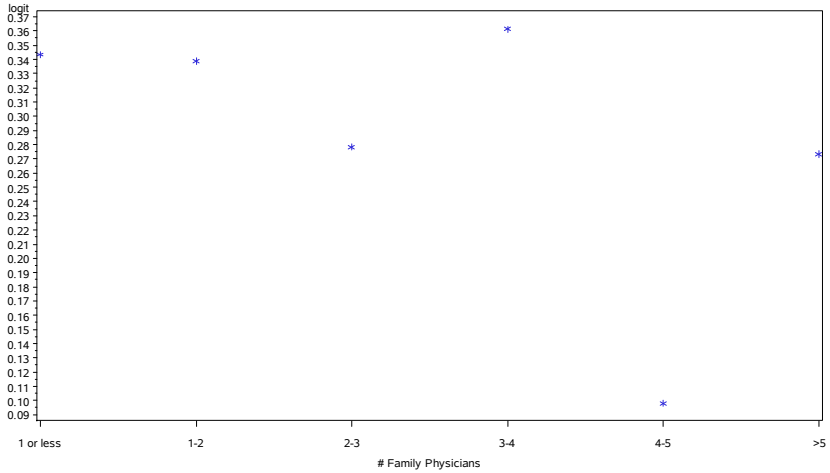
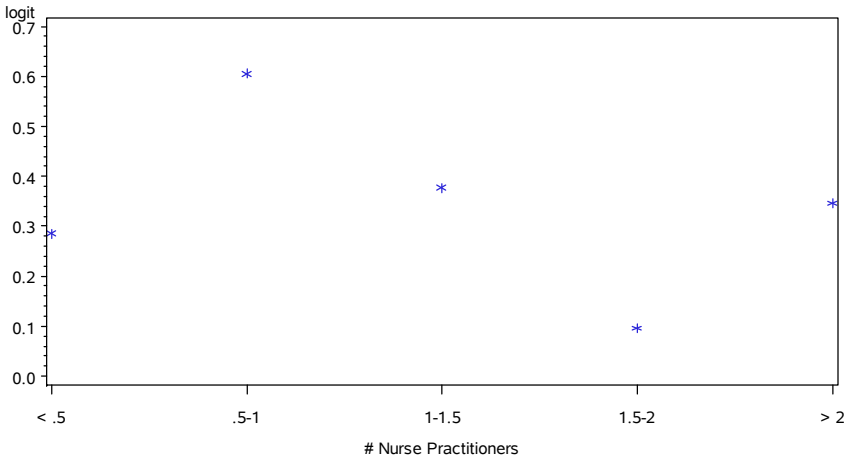
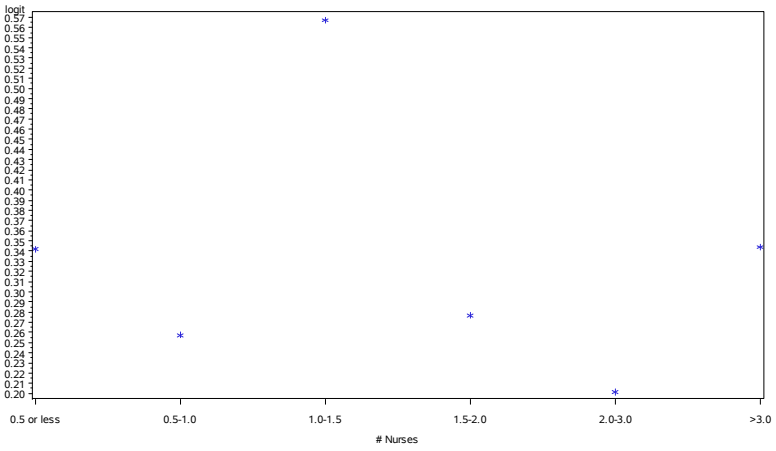
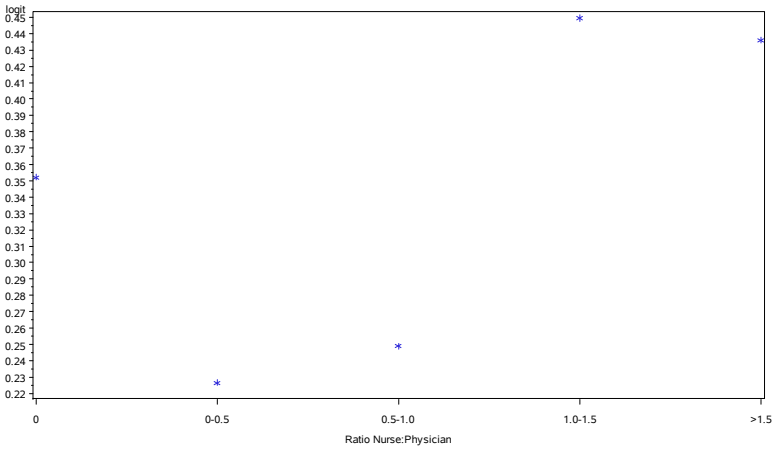


Figure 10: continued









4.4.2 Practice Level

Panel size is the only practice-level variable significantly associated with the probability of patients reporting FCC (Table 10). There is a significant quadratic relationship between panel size and the probability of patient-reported FCC.

4.4.3 Provider Level

There were no aggregated provider-level variables associated with the probability of patients reporting FCC (Table 10).

4.4.4 Patient Level

Patient sex, attending the practice for more than 5 years, having a chronic condition, and the number of family members attending the clinic were all positively associated with the probability of patients reporting FCC (Table 10). The odds of reporting FCC was 16% higher for women than for men ($p = 0.015$). Patients who reported having a chronic condition had 42 % higher odds of reporting FCC than those who didn't. Patients who had attended the practice for more than 5 years had 42 % higher odds of reporting FCC than those who had attended the practice for a shorter period of time. For each additional family member that attended the clinic the odds of reporting FCC increased by 7 %. Having an annual household income above LICO was negatively associated with the probability of reporting FCC (Table 10). Patients with an annual household income below LICO had 21% higher odds of reporting FCC than those with household incomes above LICO. There was a statistically significant quadratic relationship between patient age and the odds of reporting FCC, however, the magnitude of this relationship was negligible. There was a negative trend in the relationship between education and the probability of

patients reporting FCC, however, this was not significant (Table 10). Based on the criteria outlined previously, only patient-level variables were found to be potential confounders of patient-reported FCC. The variables that will be considered potential confounders are patient age, sex, educational attainment, annual household income, length of time attending the practice and the number of family members who attend the practice.

Table 10: Bivariable association between patient-reported FCC and characteristics of interest.

	Outcome of Predictive Model		
	Odds Ratios for reporting FCC associated with a unit increase in the predictor		
	Odds Ratio	**[95% CI]**	**p value**
Practice Characteristics			
Model of Service Delivery	overall		0.81
CHC	1.11	[0.88 - 1.40]	0.36
FFS	1.02	[0.82 - 1.28]	0.83
FHN	1.07	[0.86 - 1.34]	0.54
HSO	(reference)	-	-
Panel size[a]* - quadratic	0.96	[0.92 - 1.00]	0.042
Panel size[a]* - linear	0.97	[0.87 - 1.08]	0.59
# years clinic has been operating	1.00	[0.99 - 1.01]	0.56
# clinical services available on site	1.01	[0.98 - 1.05]	0.36
Family Physicians (FTE)	0.99	[0.96 - 1.03]	0.62
Nurse Practitioners (FTE)	0.99	[0.93 - 1.06]	0.85
Nurses (FTE[b])	1.00	[0.95 - 1.04]	0.91
Nurses (FTE[b]) per Family Physician	1.02	[0.89 - 1.16]	0.80
Electronic Medical Records	1.04	[0.88 - 1.23]	0.64
Group practices	0.96	[0.80 - 1.15]	0.67
After-hours telephone access	0.94	[0.79 - 1.12]	0.49
Setting			
Rurality index	1.00	[1.00 - 1.01]	0.12
Provider Characteristics (Aggregated)			
years since graduation	1.00	[0.99 - 1.01]	0.85
Booking interval for routine visit (min)	1.01	[0.99 - 1.02]	0.39
Sex (Female) (10%)	1.004	[0.98 - 1.02]	0.66
Patient Characteristics			
Age* - quadratic	0.999	[0.999 - 1.00]	<0.0001
Age* - linear	1.01	[1.01 - 1.01)	<0.0001
Sex (Female)	1.16	[1.03 - 1.30]	0.015
Ethnicity (White)	1.03	[0.84 - 1.26]	0.77
Education (> High School)	0.90	[0.80 - 1.01]	0.07
Chronic Condition	1.42	[1.25 - 1.61]	<0.0001
Years attending practice (> 5 yrs)	1.42	[1.24 - 1.61]	<0.0001
Household Income (> LICO)	0.79	[0.66 - 0.94]	0.009
# family members attending clinic	1.07	[1.03 - 1.11]	0.002

[a] panel size is the mean number of patients per FTE family physician (X 1000)
[b] refers to full time equivalent (FTE) nurses, registered practical nurses and nursing assistants
* Since there is a quadratic relationship with the outcome, these predictor variables are centered.

4.5 Multivariable Models

4.5.1 Missing Data Analysis

In the provider dataset, a total of 109 (30%) providers had at least one missing covariate. The variables, years since graduation and panel size were responsible for the largest proportion of missing data points as discussed below. Female providers, more nurse practitioners in the practice, longer booking interval for routine visits and more female patients were all found to be significant predictors of missing data in the provider dataset (Table 11). Provider years since graduation and panel size were both missing a substantial proportion of responses (60, or 17 %, of providers and 14, or 10 %, of practices respectively). As the number of years since providers graduated from medical or nursing school was not considered a potential confounder and it was not a significant predictor of missingness, this variable was not included in any multivariable models. Further examination supported this decision. 57 of the 60 missing responses for graduation year were found to be from providers in CHCs. Under the hypothesis that Nurse Practitioners, who are more often female, have longer booking intervals and work in CHCs serving more female patients, failed to fill out the year of graduation from medical or nursing school, the missing data analysis was rerun excluding the year of graduation. In the redone analysis, there were only 60 (17 %) providers with a missing response, and none of the variables were significant predictors of missingness.

In the patient dataset, a total of 2,347 (46%) patients had at least one missing covariate. The variables: patient income and panel size were responsible for the largest proportion of missing data points as discussed below. Only patient-level variables were found to be

significant predictors of missing data in the patient dataset, they were: age, sex, educational attainment, annual household income, ethnicity, and having been diagnosed with a chronic condition (Table 12). Those patients more likely to have missing data were females, older patients, those with lower education, those with lower incomes, non-white and those diagnosed with a chronic condition. All variables found to be significant predictors of missingness were included in the final multivariable models regardless of their significance as predictors of FCC.

Table 11: Significant bivariable predictors of missingness in the provider dataset

	Predictors of missingness in provider dataset		
	OR	**[95% CI]**	**p value**
# Nurse Practitioners (FTE)	1.28	[1.05 - 1.57]	0.016
Provider Sex (Female)	4.01	[2.37 - 6.78]	<0.0001
Booking interval (min)	1.08	[1.05 - 1.13]	<0.0001
Patient Sex (% female)	1.03	[1.00 - 1.05]	0.033

Table 12: Significant bivariable predictors of missingness in the patient dataset

	Predictors of missingness in patient dataset		
	OR	**[95% CI]**	**p value**
Patient Sex (Female)	1.18	[1.06 - 1.31]	0.002
Patient Age	1.02	[1.01 - 1.02]	<0.0001
Education (> High School)	0.66	[0.59 - 0.73]	<0.0001
Household Income (> LICO)	0.77	[0.68 - 0.89]	0.0002
Patient Ethnicity (White)	0.78	[0.65 - 0.93]	0.007
Chronic Condition	1.16	[1.04 - 1.29]	0.008

Patient income and panel size were both missing a substantial proportion of responses (1,115, or 23%, of patients and 14, or 10%, of practices respectively). Though the number of missing responses for panel size does not seem particularly large, since this is a practice-level (cluster-level) variable, all patient (575, or 11 %) and provider (38, or 10 %) observations from these practices would be dropped from any statistical model that

included panel size. The results of the sensitivity analysis around these two variables are described below.

4.5.2 Objective 1

Determine whether models of primary care service delivery differ in their provision of family-centered care.

4.5.2.1 Provider-reported FCC

Pairwise comparisons of the estimates of provider-reported FCC in each model of primary care service delivery in the unadjusted analysis showed that mean provider-reported FCC scores were significantly higher (between 5 and 7 % higher) in CHCs than in FFS, FHN or HSO (Table 13).

Adjusting for potential confounding by patient characteristics had little effect on the estimated provider-reported FCC scores or on the confidences intervals around the estimates (Table 13). However, the only pairwise comparison between models of primary care service delivery that remained significant in the adjusted analysis was that CHCs had higher provider-reported FCC scores than FHNs. These results were robust to the removal of average patient income from the regression model.

Adjusting for potential confounding by both patient and provider characteristics resulted in a slight increase in the estimated provider-reported FCC scores in FHNs and HSOs as well as a slight increase in the confidence interval around the estimate for all models of primary care service delivery. Pairwise comparisons between provider-reported FCC estimates in each model of primary care service delivery did not show any change as a result of adjusting for provider characteristics, the only significant difference remained

between CHCs and FHNs. These results were robust to the removal of average patient income from the regression model.

Table 13: Least square mean estimates of provider-reported FCC by model of primary care service delivery, crude and adjusted analysis

	Association with Model of Service Delivery					
	MODEL 1.A **Unadjusted**		**MODEL 1.B** **Adjusted** (Patient)		**MODEL 1.C** **Adjusted** (Patient & Provider)	
Provider-Reported FCC	FCC Estimate [95% CI]		FCC Estimate [95% CI]		FCC Estimate [95% CI]	
CHC	0.89 [0.87 - 0.91]		0.89 [0.87 - 0.91]		0.89 [0.86 - 0.91]	
FFS	0.84 [0.82 - 0.87]		0.84 [0.81 - 0.87]		0.84 [0.81 - 0.88]	
FHN	0.82 [0.80 - 0.85]		0.82 [0.80 - 0.85]		0.83 [0.80 - 0.85]	
HSO	0.83 [0.80 - 0.86]]		0.83 [0.80 - 0.87]		0.84 [0.80 - 0.88]	
	Pairwise comparison [p value]	Mean Difference [95% CI]	Pairwise comparison [p value]	Mean Difference [95% CI]	Pairwise comparison [p value]	Mean Difference [95% CI]
Significant pairwise comparisons with Tukey adjustment	CHC>FFS [0.024] CHC>FHN [0.0001] CHC>HSO [0.004]	0.047 [0.015 - 0.079] 0.066 [0.037 - 0.096] 0.061 [0.026 - 0.095]	CHC>FHN [0.004]	0.069 [0.029 - 0.108]	CHC>FHN [0.035]	0.061 [0.017 - 0.105]

4.5.2.2 Patient-reported FCC

The effect of the model of primary care service delivery on the probability of patients reporting FCC was not significant in the unadjusted analysis (Table 14).

Adjusting for potential confounding by patient characteristics increased the estimated odds ratios for reporting FCC in each model of primary care service delivery as well as the confidence intervals around each estimate (Table 14). The effect of the model of primary care service delivery on the odds of patients reporting FCC remained non-significant in the adjusted analysis. The sensitivity analysis around removing household income as a predictor due to large amounts of missing data resulted in a higher estimated odds ratio for CHCs and the p-value approached 0.05, however it did not become

significant (results not shown). The rest of the results showed no substantial change and the overall effect of the model of primary care service delivery on the odds of patients reporting FCC remained non-significant (results not shown).

Based on the criteria for confounding, no aggregated provider characteristics were considered potential confounders of the relationship between model of primary care service delivery and patient-reported FCC, therefore no further adjusted statistical models were fit (Table 14).

Table 14: Odds Ratios for patient-reported FCC by model of primary care service delivery, crude and adjusted analysis

		Association with Model of Service Delivery		
		MODEL 2.A **Unadjusted**	**MODEL 2.B** **Adjusted** **(Patient)**	**MODEL 2.C** **Adjusted** **(Patient & Provider)**
Patient-Reported FCC		OR [95% CI]	OR [95% CI]	OR [95% CI]
	CHC	1.11 [0.88 - 1.40]	1.18 [0.90 - 1.54]	No provider-level confounders
	FFS	1.02 [0.82 - 1.28]	1.13 [0.88 - 1.46]	No provider-level confounders
	FHN	1.07 [0.86 - 1.34]	1.08 [0.85 - 1.39]	No provider-level confounders
	HSO	-	-	No provider-level confounders
		No Differences	No Differences	N/A

4.5.3 Objective 2

Identify organizational characteristics of primary care practices associated with higher scores for family-centered care.

4.5.3.1 Provider-reported FCC

Table 15 shows the results of the reduced multivariable model of provider-reported FCC scores adjusted for confounding by patient characteristics. The intercept represents the

adjusted mean estimate of the FCC score for the average provider. The number of clinical services available on site, after-hours telephone access and the number of nurse practitioners were all positively associated with provider-reported FCC scores. Each additional service available on site was associated with a 0.6 % increase in the provider-reported FCC score. Having after-hours telephone access was associated with a 2.6 % increase in provider-reported FCC scores compared to those who did not have it. Each additional full time equivalent nurse practitioner was associated with a 1.3 % increase in provider-reported FCC scores. The number of full time equivalent family physicians and the Rurality index were both negatively associated with provider-reported FCC. Each additional family physician was associated with a 0.7 % decrease in provider-reported FCC scores. For each 1 unit increase in the Rurality index there was a 0.06 % decrease in the provider-reported FCC score. Aggregated patient-level variables identified as confounders were retained in the model. The only aggregated patient-level variable that was a significant predictor of provider-reported FCC scores in the adjusted analysis was the proportion of female patients in a practice. Each 10 % increase in the proportion of female patients was associated with a 0.9% increase in provider-reported FCC scores. The results did not change substantially when the average patient income at the practice was removed from the regression model.

Table 16 shows the results of the reduced multivariable model of provider-reported FCC scores adjusted for confounding by both patient and provider characteristics. The intercept represents the adjusted mean estimate of the FCC score for the average provider in the reference category for each categorical predictor. The adjusted mean estimate of

the FCC score for the average provider is lower when adjusting for provider characteristics compared to when only adjusting for patient characteristics (0.81 vs. 0.84). After-hours telephone access and Rurality index were no longer significant predictors of provider-reported FCC scores once adjustments were made for provider-level confounders. The direction and magnitude of the associations between the other practice-level variables in the multivariable model and provider-reported FCC were very similar to what was found in the model adjusting for confounding only by patient characteristics. The proportion of female patients at a practice was no longer a significant predictor of provider-reported FCC once adjustments were made for provider-level variables. The results did not change substantially when the average patient income at the practice was removed from the regression model.

Table 17 shows the results of the reduced multivariable model of provider-reported FCC scores, adjusted for confounding by both patient and provider characteristics, with the model of primary care service delivery reintroduced. The model for primary care service delivery was not significantly associated with provider-reported FCC in the adjusted model. The intercept represents the adjusted mean estimate of the FCC score for the average provider in the reference categories. The adjusted mean estimate of the FCC score for the average provider and most of the parameter estimates did not change substantially with the addition of the model of primary care service delivery. Adding the model of primary care service delivery to the adjusted regression model rendered the effect of the # of FTE nurse practitioners non-significant. This indicates that there was no additional variability explained by the model of primary care service delivery and that the other variables represented the effect of the model of primary care service delivery seen

in the bivariable analysis. Furthermore, the results did not change substantially if average patient income was removed from the regression model.

Table 15: Results of the reduced multivariable mixed regression model of provider-reported FCC (adjusted for confounding by patient characteristics).

	Outcome of Predictive Model		
	Multivariable association with provider-reported FCC		
Intercept = 0.8412	β	[95% CI]	p value
Practice Characteristics			
# clinical services available on site	0.006	[0.0008 - 0.012]	0.03
After-hours telephone access	0.026	[-0.003 - 0.055]	0.08
Family Physicians (FTE)	-0.007	[-0.012 - -0.001]	0.01
Nurse Practitioners (FTE)	0.013	[-0.004 - 0.022]	0.007
Setting			
Rurality Index	-0.0006	[-0.001 - 0.00005]	0.07
Patient Characteristics (Aggregated)			
Sex (% Female)	0.009	[-0.00001 - 0.018]	0.05
Years attending practice (> 5 yrs) (%)	0.0002	[-0.006 - 0.006]	0.96
Household Income (> LICO) (%)	0.002	[-0.006 - 0.009]	0.61
# family members attending clinic	-0.02	[-0.044 - 0.007]	0.15

Table 16: Results of the reduced multivariable mixed regression model of provider-reported FCC (adjusted for confounding by patient and provider characteristics).

	Outcome of Predictive Model		
	Multivariable association with provider-reported FCC		
Intercept = 0.8124	β	[95% CI]	p value
Practice Characteristics			
# clinical services available on site	0.007	[0.002 - 0.012]	0.01
Family Physicians (FTE)	-0.008	[-0.013 - -0.002]	0.007
Nurse Practitioners (FTE)	0.011	[0.0007 - 0.021]	0.04
Provider Characteristics			
Booking interval for routine visit	-0.0002	[-0.002 - 0.002]	0.87
Sex (Female)	0.021	[-0.002 - 0.044]	0.08
Patient Characteristics (Aggregated)			
Sex (10% Female)	0.01	[-0.0035 - 0.016]	0.21
Years attending practice (> 5 yrs) (10%)	0.0008	[-0.006 - 0.007]	0.82
Household Income (> LICO) (10%)	-0.002	[-0.01 - 0.006]	0.63
# family members attending clinic	-0.02	[-0.049 - 0.003]	0.09

Table 17: Results of the reduced multivariable mixed regression model of provider-reported FCC (adjusted for confounding by patient and provider characteristics) with the model of primary care service delivery added.

	Outcome of Predictive Model		
	Multivariable association with provider-reported FCC		
Intercept = 0.8060	β	[95% CI]	p value
Practice Characteristics			
# clinical services available on site	0.007	[0.001 - 0.012]	0.02
Family Physicians (FTE)	-0.007	[-0.013 - -0.0009]	0.03
Nurse Practitioners (FTE)	0.009	[-0.005 - 0.022]	0.19
Model of Service Delivery	overall		0.81
CHC	0.020	[-0.040 - 0.078]	0.52
FFS	0.010	[-0.030 - 0.055]	0.56
FHN	-0.001	[-0.043 - 0.041]	0.96
HSO	(reference)	-	-
Provider Characteristics			
Booking interval for routine visit	-0.0003	[-0.002 - 0.002]	0.77
Sex (Female)	0.02	[-0.003 - 0.043]	0.09
Patient Characteristics (Aggregated)			
Sex (10% Female)	0.005	[-0.005 - 0.015]	0.28
Years attending practice (> 5 yrs) (10%)	0.001	[-0.005 - 0.008]	0.71
Household Income (> LICO) (10%)	-0.0007	[-0.009 - 0.008]	0.87
# family members attending clinic	-0.02	[-0.049 - 0.005]	0.11

4.5.3.2 Patient-reported FCC

Table 18 shows the results of the reduced multivariable model of practice organizational characteristics and patient-reported FCC adjusted for confounding by patient characteristics. Patient-level variables previously identified as confounders as well as those shown to predict missingness were retained in the model regardless of significance. There were no practice organizational characteristics retained in the model as significant predictors of patient-reported FCC at the 10 % significance level. The practice panel size was the last remaining practice-level variable in the backwards elimination and it approached significance with a p value of 0.115. Each increase of 1000 in the mean

number of patients per family physician was associated with an 8% drop in the odds of patients reporting FCC (results not shown). However, as this did not meet our pre-specified criteria for model building panel size was removed from the model. Patient sex, whether they had been attending the practice for more than 5 years and the number of family members attending the clinic were all significant positive predictors of patients reporting FCC. Being female was associated with a 23 % increase in the odds of reporting FCC compared to males. Attending the practice for more than 5 years was associated with a 35 % increase in the odds of reporting FCC compared to those who had attended the practice for a shorter time. Each additional family member attending the practice was associated with a 10 % increase in the odds of reporting FCC. Annual household income and having been diagnosed with a chronic condition were negatively associated with the odds of patients reporting FCC in the adjusted analysis. Having an annual household income below the low income cut off (LICO) was associated with a 22 % increase in the odds of reporting FCC. Having been diagnosed with a chronic condition was associated with a 23 % decrease in the odds of reporting FCC. There was a significant quadratic relationship between patients' age and the probability of reporting FCC in the adjusted analysis. The regression analysis was rerun excluding household income and panel size from the outset as part of the sensitivity analysis related to missing observations for these two variables. There were no substantial changes in the results with the removal of these two variables.

Table 18: Results of the reduced marginal logistic regression model of practice organizational characteristics and patient-reported FCC (adjusted for confounding by patient characteristics).

	Outcome of Predictive Model		
	Multivariable association with patient-reported FCC		
	OR	[95% CI]	p value
Patient Characteristics			
Sex (Female)	1.23	[1.06 - 1.43]	0.002
Age - quadratic	0.990	[0.9992 - 0.9997]	< 0.0001
Age - linear	0.994	[1.01 - 1.02]	< 0.0001
Years attending practice (> 5 yrs)	1.353	[1.15 - 1.59]	0.0003
Education (> High School)	0.88	[0.75 - 1.03]	0.12
Household Income (> LICO)	0.78	[0.64 - 0.96]	0.0002
# family members attending clinic	1.10	[1.04 - 1.16]	0.00
Chronic Condition	0.77	[0.66 - 0.91]	0.002
Ethnicity (White)	1.06	[0.82 - 1.38]	0.65

Chapter 5: Discussion

5.1 General summary of findings

5.1.1 Objective 1

Determine whether models of primary care service delivery differ in their provision of family-centered care.

Adjusting for patient characteristics, primary care providers in Community Health Centers reported on average 7% [95%CI: 3 – 11%] higher family-centeredness scores than those in Family Health Networks. This is equivalent to giving four "more positive" responses (e.g. moving one positive response higher from "Probably" to "Definitely" on four questions; or moving three positive responses higher from "Definitely Not" to "Definitely" on one question and moving one positive response from “Probably” to “Definitely” on a second question). Adjusting for potential confounding by provider characteristics did not change the results. There was no statistically significant association between the model of primary care service delivery and whether patients reported family-centered care.

5.1.2 Objective 2

Identify organizational characteristics of primary care practices associated with family-centered care.

Adjusting for patient characteristics, provider-reported family centeredness scores are higher with a greater number of clinical services available on site, the presence of after-hours telephone access and a greater number of nurse-practitioners within a practice. Provider-reported family centeredness scores are lower with a higher number of family

physicians at the practice and a higher Rurality index for the practice. Making further adjustments for provider characteristics resulted in a slightly lower mean estimate of the family-centeredness score for the average provider. In addition, it caused two variables, the presence of after-hours telephone access and Rurality, to be dropped from the statistical model as they were no longer significant predictors of provider-reported family-centeredness. The magnitude and direction of the effects of the other variables on the family-centeredness scores remained largely unchanged. Once practice organizational factors had been taken into account there was no additional effect of the model of primary care service delivery on provider-reported family-centeredness. This indicates that the aforementioned 7% higher scores in Community Health Centers versus Family Health Networks, can be attributed to the organizational characteristics tested here, namely the number of clinical services available on site, and more nurse-practitioners and family physicians at the practice.

Most patients report that they receive family-centered care. When adjusting for potential confounding by patient characteristics, larger panel size tended to be associated with fewer patients reporting family-centered care, however this association was not statistically significant. The best predictors of the probability of patients reporting family-centered care are all patient-level characteristics. However, since causation cannot be established from these data it is unknown, for example, whether females are more likely to report family-centered care because they tend to give higher scores, or if providers actually treat them differently.

5.2 Interpretation

This appears to be the first study of its kind and as such can contribute to the literature on family-centeredness by offering the first broad look at what factors influence the delivery of family centered care. Bamm and Rosenbaum stated, in their synthesis on the theory and evolution of the family-centered concept, that there is no evidence to date of the effect of demographic characteristics on patient reports for family-centered care[20]. They did speculate that patient age and sex may be relevant as family-centered care is known to be related to patient satisfaction and females and older patients tend to be more satisfied with care. This thesis may be useful in shedding some light in this area. Though it was not one of the main objectives of the thesis, relationships between patient demographic variables and reporting of family-centered care were found. In support of Bamm and Rosenbaum's speculation, female sex and age were found to be significantly associated with patients reporting family-centered care, however the magnitude of the effect of age was extremely small and likely has no clinical relevance. We also identified relationships between socio-economic factors and the odds of reporting family-centered care. Patients whose annual household income fell below the low income cut off, that is, those in the lowest economic brackets, had nearly 30% greater odds of reporting family-centered care. This remained true even when adjustments were made for age, sex, educational attainment, years with the practice, number of family members attending the clinic and average panel size at their practice. If the patient reported ever having been diagnosed with a chronic condition they had 40% greater odds of reporting family-centered care. Similarly, patients who had been with the practice for more than five years also had 40% greater odds of reporting family-centered care. This may show that the measure of

family-centered care is acting as a proxy for the patient-provider relationship since these patients, due to factors such as more frequent interactions with physicians for those with chronic conditions and the length of relationship for those who have been with the practice for an extended period of time, may have had more time and opportunity to build relationships with their providers, including the aspects related to family-centered care. These findings indicate that demographic factors may be important when assessing patient reports of family-centered care. In particular, age, sex, the number of family members attending the clinic, the presence of a chronic condition, the length of time with the practice and economic factors should be taken into account in any future studies looking at patient assessments of family-centered care.

5.3 Limitations

5.3.1 Patient Sampling Strategy

The original study recruited patients from the waiting rooms of participating practices. While direct contact with the patients increased the recruitment rate (compared to a mailed survey for example[49]) the sample of patients is biased towards those patients who are more likely to attend the practice. This is seen in the study sample as a likely over sampling of women, older patients and those with a chronic condition. As a result, the findings of this thesis are not generalisable to the entire population of patients served by a practice but are weighted towards those who attend more frequently. Since we are interested in the care provided, getting more data from those who attend more often may be appropriate. Furthermore, since the objective of this thesis was to compare the

provision of family-centered care among models of primary care service delivery, rather than report on the state of family-centered care across Ontario, the issue of internal validity is more relevant than external validity. As patient recruitment strategies were identical in each practice, any bias due to the sampling strategy is likely to be similar in the different models and will therefore not affect the comparison among models. However, if there is a relationship between family-centered care and practice attendance, perhaps those who experience less family-centered care are less likely to attend. This may have resulted in a bias towards more reporting of family-centered care in the overall sample, but is unlikely to have affected comparisons among models.

3.3.2 Patient-reported Family-centeredness

The creation of the dichotomized version of family-centeredness utilized conservative assumptions about the likelihood of reporting FCC. This conservative approach was carried out because family-centeredness scores were very high and a method of teasing out the variation in responses was sought. This dichotomization has not been validated and indeed, there are n = 284 patients (6% of all patients included in this analysis) who could be classified as either reporting or not reporting family-centered care, depending on how one chose to categorize those patients with "Definitely" as responses to two questions but who had a missing response for the third question. The more conservative approach used in this thesis categorized them as not reporting family-centered care as outlined in section 3.3.2. A limited sensitivity analysis was carried out using the less-conservative approach for dichotomizing patient-reported family-centeredness scores. This did not change the conclusion that model of primary care service delivery did no appear to be associated with the odds of reporting family-centered care. However,

dichotomizing the scores instead of using a continuous score may have affected our ability to detect an effect. Overall, when using the family-centeredness scale from the PCAT, patients tended to report very high family-centeredness and any attempt to look at the variability in responses was hampered by this ceiling effect. A different tool, or perhaps an expanded version of the PCAT family-centeredness scale with more questions, might offer better resolution for those carrying out further research examining patient-reports of family-centered care.

5.3.3 Missing Patient-level Data

Missing data, in terms of incomplete responses to surveys, is one of the problems associated with a cross sectional survey design. This can cause biased results, particularly if failure to respond to a specific question is associated with the outcome of interest. There was a substantial amount of missing data in the patient-level analysis. In large part this was due to two variables, household income and panel size. While these variables could have been excluded from the outset, it was felt that they were potentially important predictors of family-centered care and were therefore retained as candidate predictors. In order to test the sensitivity of the final regression models to the missing observations, a sensitivity analysis was conducted where household income and panel size were excluded as candidate predictors. This sensitivity analysis indicated that our results were robust and the removal of these two predictors did not have an appreciable impact on the interpretation of our final regression models.

One approach for dealing with missing data in the analysis is imputation, i.e., substitution of missing responses with an estimated or predicted value. The "gold standard" for imputing missing data is multiple imputation[47]. This method for imputing data uses

regression models to predict multiple estimates of a missing value from a distribution generated from the available data[47,50]. Multiple imputation is the preferred statistical method for imputation[47], and some extensions have been made to apply it to multivariable linear mixed models[50]. However, the methodology for multiple imputation in clustered data is not yet well developed[51] and no procedures exist in the SAS software to carry out such imputation. Therefore, no attempt was made to carry out multiple imputation for the missing values. As a result, this analysis was based on complete cases, that is, only subjects with complete data were included in the analysis. Assuming that data are Missing At Random, a complete case analysis is unbiased, as long as all factors associated with missingness are included as predictors in the analysis[46].

5.3.3 Unequal Cluster Size

The number of patients or providers per practice (i.e.: cluster size) varied in this study. Though recognition of the importance of accounting for the non-independence of observations in clustered trials through the use of a variance inflation factor (or design effect) is becoming more common, the impact of unequal cluster sizes is often overlooked[52]. Variations in cluster size can occur for several reasons[53,54], the reasons most relevant to this study are: variation in the actual size of clusters (e.g.: the number of providers at a given practice is directly related to the number of providers participating from that practice) and variation in recruitment rates among clusters/practices (particularly relevant for patients). The size of each cluster is important since a larger cluster size leads to a more precise estimate of the variable to be measured while a smaller cluster has a less precise estimate. Since the effect on precision of adding more individuals to a cluster decreases as the size of the cluster increases, the increases in the

precision of estimates for large clusters do not outweigh the loss of precision in smaller clusters leading to an overall decrease in power[52]. Several authors have proposed methods for accounting for the loss of power associated with unequal cluster sizes when carrying out sample size calculations[52,54-57]. When sample size calculations were carried out for the original study on which this thesis was based, adjustments were made to account for the clustering of patients by practice, however, no adjustments were made for the possibility of variable cluster size therefore the power of this study may be lower than what was originally anticipated. Studies using clustered data are particularly common in primary care research given the natural clustering of patients and providers within practices[52,53,57]. Eldridge et al demonstrated that a sample size increase of up to 42% was commonly required when accounting for variable cluster size in studies carried out in UK general practices[52]. However, since Hoenig and Heisey outlined the limitations of carrying out post-hoc power calculations, calculations to determine the effect of the unequal cluster sizes were not carried out for this thesis[58]. However, given the large sample size and that the sample size calculations were carried out for the disease prevention performance variable, which was not used in this thesis, with the understanding that it would require a larger sample size than the other variables collected to show an effect, the impact of the power loss on this thesis is likely minimal. It is possible that, due to the loss of power from unequal cluster sizes, the effect of some variables was not detected. However, given the relatively small effects that were detected, it is doubtful that any effects not detected would have clinical or policy relevance.

5.3.4 Study Design and Causation

There are inherent limitations to cross-sectional studies, chief among them that the inference of causation cannot be made as the temporal relationship between predictors and outcomes is unknown. In this thesis this can translate to whether the model of primary care service delivery or any practice organizational characteristics found to be associated with patient/provider-reported family-centeredness

A brief look at another possible study design to address the objectives of this thesis highlights different issues. A cohort study of this size attempting to track patients and providers through their experiences of changing practice organization would be prohibitively expensive and may bring along issues specific to cohort studies such as loss to follow up and how to address practices that switch from one model to another over the course of the study. Recognizing that there are limitations to cross-sectional studies, the snapshot afforded by this study provides evidence that there are associations between practice organizational characteristics and family-centered care. This may inform future studies that would aim to determine if these are causal relationships by employing different study designs.

Bradford-Hill identified nine criteria for establishing causation, including the temporal relationship mentioned earlier[59]. Future studies could aim to determine whether the associations found here are causal by addressing the following eight criteria. The first relates to the strength of the association and can be evaluated based on the size of the effect, in this study there was a moderate size effect on provider-reported FCC due to the model of primary care service delivery. The second criterion relates to the consistency of

evidence for the association, this cannot yet be addressed as this is the first study examining the effect of practice organization on FCC, if further research is carried out in this area a causal relationship would be supported if multiple studies provide evidence supporting our conclusions. The third criterion relates to specificity, whether a change in the predictor results in a corresponding change in the outcome, and is again a shortfall of a cross sectional design as there is no opportunity to change the predictor (e.g.: transition to a new model of care) and observe whether this increases the provision of FCC. This could, in theory, be addressed with a randomized controlled trial where practices are randomly assigned to incorporate a predictor of FCC, e.g.: providing a Nurse Practitioner, and assessing whether this results in greater provision of FCC. The assessment of a dose-response relationship offers further evidence of causation, e.g.: that the presence of two Nurse Practitioners has a greater impact on FCC than the presence of a single one. The fifth criterion, plausibility, can be argued as organization and remuneration of primary care services have been found to influence many aspects of quality of care and provider behaviour[24-26], so it stands to reason that they may have an influence on FCC. The criterion for coherence, where the evidence is viewed in the context of the natural history of the outcome, is more related to a biological method of causation and is not as easily adapted to a study of health services delivery. The seventh criterion is experimental evidence showing a relationship between two variables and, like the second criterion, this cannot be established at this time due to the lack of research in this area to date. The final criterion for causation is reasoning by analogy, that is, whether the observed association is supported by similar associations in different areas; this could be examined by looking

at the impact of practice organization on other aspects of the patient provider relationship, such as trust or communication.

5.4 Strengths

Despite the inherent limitations, there are considerable strengths to this study.

As there has been very little work done to date assessing family-centered care and the factors that may influence it, this study is important in terms of creating a starting point for further research.

Recruiting practices and physicians is a recognized challenge in primary care research. The original study employed several different methods to increase the recruitment rate, including multiple mailings, telephone calls and face-to-face visits as well as compensation to practices for the time involved in completing surveys[10]. As a result of these efforts our response rate was generally good which decreases the chance of self-selection bias where practices that choose to participate are different than those who choose not to participate in the study. The possibility of self-selection bias was further assessed by using administrative databases to compare participating to non-participating practices across a range of characteristics. The practices and providers that participated in the study were found to be broadly comparable to those that did not participate on all characteristics measured[10]. This indicates that the risk of self-selection bias is likely minimal.

The large sample size recruited means that the study was adequately powered to detect an effect in our measures of family-centered care. Furthermore, the sample size allowed us to include a large number of candidate predictor variables in our multiple regression analyses allowing us to adjust for many different factors simultaneously.

The broad geographical representation achieved from the Ontario-wide sampling base means that these results are generalisable across the province, with the previously noted exception of the far northern areas of the province which were not sampled.

Extensive work was put into developing the survey used in the original study. To create the original survey, standardized tools were incorporated from multiple sources including the family-centeredness scales, taken from the PCAT, that were used as the primary outcomes in this thesis. The family-centeredness scales were validated by Shi et al who reported on the validity and reliability of all scales in the PCAT[34]. Since a standard, validated tool was used, the results of this study will be comparable to any other research that uses these scales to assess the extent of family-centeredness in primary care.

5.5 Conclusions

Patients and primary care providers both report high levels of family-centered care. Particularly with respect to patients, attempting to tease apart the variation in the high scores presents significant challenges.

Primary care providers in Community Health Centers report more family-centered care than those in Family Health Networks. There does not appear to be any relationship between the model of primary care service delivery and whether or not patients report family-centered care, however, this may be due to the limitations of our patient-reported measure. There are several organizational characteristics of primary care practices that are associated with provider-reported family-centeredness while practice organizational characteristics do not appear to affect whether patients report family-centered care. As very little work has been done to date examining family-centered care in a primary care

setting this thesis presents an important stepping stone, highlighting that there are factors that may influence the provision of family-centered care, and will hopefully inform the generation of research questions on this topic.

Future research could focus on developing a more informative patient-level measure of family-centered care; determining whether any of the associations observed in this study are causal; measuring the impact of family-centered care on patient satisfaction with health care, or provider job-satisfaction; or assessing the impact of family-centered care on patient health outcomes.

References

(1) Muldoon LK, Hogg WE, Levitt M. Primary care (PC) and primary health care (PHC). What is the difference? Can J Public Health 2006 Sep;97(5):409-11.

(2) Starfield B. Primary Care: Balancing Health Needs, Services and Technology. New York: Oxford University Press; 1998.

(3) Campbell SM, Roland MO, Buetow SA. Defining quality of care. Soc Sci Med 2000 Dec;51(11):1611-25.

(4) Donabedian A. Evaluating the quality of medical care. Milbank Mem Fund Q 1966 Jul;44(3):Suppl-206.

(5) Donaldson MS, Yordy KD, Lohr KN, Vanselow NA, (ed.). Primary Care: America's Health in a New Era. 1996. Washington, National Academy Press.

(6) Hogg W, Rowan M, Russell G, Geneau R, Muldoon L. Framework for primary care organizations: the importance of a structural domain. Int J Qual Health Care 2008 Oct;20(5):308-13.

(7) Kelley E, Hurst J. Health Care Quality Indicators Project: Conceptual Framework Paper. Paris: Organization for Economic Co-operation and Development; 2006. Report No.: 23.

(8) Sibthorpe B. A Proposed Conceptual Framework for Performance Assessment in Primary Health Care: a Tool for Policy and Practice. 2004. Canberra, Australian Primary Health Care Research Institute. http://www.anu.edu.au/aphcri/Publications/conceptual_framework.pdf

(9) Watson DE, Broemeling AM, Reid RJ, Black C. A Results-Based Logic Model for Primary Health Care: Laying an evidence-based foundation to guide performance measurement, monitoring and evaluation. 2004. Vancouver, Centre for Health Services and Policy Research, University of British Columbia. http://www.chspr.ubc.ca/files/publications/2004/chspr04-19.pdf

(10) Dahrouge S, Hogg W, Russell G, Geneau R, Kristjansson E, Muldoon L, et al. The Comparison of Models of Primary Care in Ontario study (COMP-PC): Methodology of a multifaceted cross-sectional practice-based study. Open Medicine 2009;3(3):149-64.

(11) Haggerty J, Burge F, Levesque JF, Gass D, Pineault R, Beaulieu MD, et al. Operational definitions of attributes of primary health care: consensus among Canadian experts. Ann Fam Med 2007 Jul;5(4):336-44.

(12) Ngui EM, Flores G. Satisfaction with care and ease of using health care services among parents of children with special health care needs: the roles of

race/ethnicity, insurance, language, and adequacy of family-centered care. Pediatrics 2006 Apr;117(4):1184-96.

(13) Kain ZN, Caldwell-Andrews AA, Mayes LC, Weinberg ME, Wang SM, Maclaren JE, et al. Family-centered preparation for surgery improves perioperative outcomes in children: a randomized controlled trial. Anesthesiology 2007 Jan;106(1):65-74.

(14) Rodriguez-Osorio CA, Dominguez-Cherit G. Medical decision making: paternalism versus patient-centered (autonomous) care. Curr Opin Crit Care 2008 Dec;14(6):708-13.

(15) LeGrange D., Crosby RD, Lock J. Predictors and moderators of outcome in family-based treatment for adolescent bulimia nervosa. J Am Acad Child Adolesc Psychiatry 2008 Apr;47(4):464-70.

(16) Institute of Medicine. Defining primary care: an interim report. 1994. Washington, DC, National Academy Press.

(17) Canadian College of Family Physicians. Four Principles of Family Medicine. 2011. 8-10-2010. http://www.cfpc.ca/English/cfpc/about%20us/principles/default.asp?s=1

(18) Institute for Family-Centered Care. Adult Health Care Bibliography. 2010. http://www.ipfcc.org/advance/BI_Adult_Healthcare_032010.pdf

(19) Institute for Family-Centered Care. Patient- and Family- centered care selected references and resources. 2011. http://www.vipcs.org/conf2005/Johnson9.pdf

(20) Bamm EL, Rosenbaum P. Family-centered theory: origins, development, barriers, and supports to implementation in rehabilitation medicine. Arch Phys Med Rehabil 2008 Aug;89(8):1618-24.

(21) Franck LS, Callery P. Re-thinking family-centred care across the continuum of children's healthcare. Child Care Health Dev 2004 May;30(3):265-77.

(22) Goldberg DG, Mick SS. Medical home infrastructure: effect of the environment and practice characteristics on adoption in Virginia. Med Care Res Rev 2010 Aug;67(4):431-49.

(23) Muldoon L, Rowan MS, Geneau R, Hogg W, Coulson D. Models of primary care service delivery in Ontario: why such diversity? Healthc Manage Forum 2006;19(4):18-23.

(24) Gosden T, Pedersen L, Torgerson D. How should we pay doctors? A systematic review of salary payments and their effect on doctor behaviour. QJM 1999 Jan;92(1):47-55.

(25) Haggerty JL, Pineault R, Beaulieu MD, Brunelle Y, Gauthier J, Goulet F, et al. Practice features associated with patient-reported accessibility, continuity, and coordination of primary health care. Ann Fam Med 2008 Mar;6(2):116-23.

(26) Russell GM, Dahrouge S, Hogg W, Geneau R, Muldoon L, Tuna M. Managing chronic disease in ontario primary care: the impact of organizational factors. Ann Fam Med 2009 Jul;7(4):309-18.

(27) Rosenthal MB. Beyond pay for performance--emerging models of provider-payment reform. N Engl J Med 2008 Sep 18;359(12):1197-200.

(28) Devlin RA, Sarma S, Hogg W. Remunerating primary care physicians: emerging directions and policy options for Canada. Healthc Q 2006;9(3):34-42.

(29) Russell GM. The family practice care of patients with occupational injuries [Dissertation] Faculty of Medicine, Department of General Practice. University of Western Australia; 2007.

(30) Health Canada. Health Care System. 5-20-2009. http://www.hc-sc.gc.ca/hcs-sss/index-eng.php

(31) Baskerville NB, Hogg W, Lemelin J. The effect of cluster randomization on sample size in prevention research. J Fam Pract 2001 Mar;50(3):W241-W246.

(32) Starfield B. Adult Primary Care Assessment Tool - Expanded Version (consumer-client survey). 1998. Primary Care Policy Center, Johns Hopkins University, School of Hygiene and Public Health.

(33) Starfield B. Adult Primary Care Assessment Tool - Abridged Version (consumer-client survey). 1998. Primary Care Policy Center, Johns Hopkins University, School of Hygiene and Public Health.

(34) Shi L, Starfield B, Xu J. Validating the Adult Primay Care Assessment Tool. Journal of Family Practice 2001;50(2):E1.

(35) College of Family Physicians of Ontario. Updated data release of the 2001 National Family Physician Workforce Survey. 2002.

(36) Statistics Canada. Low Income Cut-offs for 2005 and Low Income Measures for 2004. 2006. http://www.statcan.ca/english/research/75F0002MIE/75F0002MIE2006004.pdf

(37) Donner A. An empirical study of cluster randomization. Int J Epidemiol 1982 Sep;11(3):283-6.

(38) Killip S, Mahfoud Z, Pearce K. What is an intracluster correlation coefficient? Crucial concepts for primary care researchers. Ann Fam Med 2004 May;2(3):204-8.

(39) Zyzanski SJ, Flocke SA, Dickinson LM. On the nature and analysis of clustered data (editorial). Ann Fam Med 2004;2(3):199-200.

(40) Kenward MG, Roger JH. Small sample inference for fixed effects from restricted maximum likelihood. Biometrics 1997 Sep;53(3):983-97.

(41) SAS [computer program]. Version 9.1. Cary, NC: SAS Institute; 2004.

(42) Hogg W, Dahrouge S, Russell G, Tuna M, Geneau R, Muldoon L, et al. Health Promotion Activity in Primary Care: Performance of Models, and Associated Factors. Open Medicine 2009;3(3):165-73.

(43) Mickey RM, Greenland S. The impact of confounder selection criteria on effect estimation. Am J Epidemiol 1989 Jan;129(1):125-37.

(44) Brookhart MA, Sturmer T, Glynn RJ, Rassen J, Schneeweiss S. Confounding control in healthcare database research: challenges and potential approaches. Med Care 2010 Jun;48(6 Suppl):S114-S120.

(45) Little RJA, Rubin DB. Statistical Analysis with Missing Data. New York: Wiley; 1987.

(46) Fitzmaurice GM, Laird NM, Ware JH. Applied Longitudinal Analysis. Hoboken, New Jersey: Wiley-Interscience, A John Wiley & Sons, Inc.; 2004.

(47) Janssen KJ, Vergouwe Y, Donders AR, Harrell FE, Jr., Chen Q, Grobbee DE, et al. Dealing with missing predictor values when applying clinical prediction models. Clin Chem 2009 May;55(5):994-1001.

(48) Singer JD. Using SAS PROC MIXED to fit multilevel models, hierarchical models and individual growth models. Journal of Educational and Behavioral Statistics 1998;24(4):323-55.

(49) Wensing M, Grol R, Smits A, Van MP. Evaluation of general practice care by chronically ill patients: effect of the method of administration. Fam Pract 1996 Aug;13(4):386-90.

(50) Schafer JL. Imputation of missing covariates under a multivariate linear mixed model. Penn State, Department of Statistics; 1997. Report No.: 4.

(51) DeSouza CM, Legedza AT, Sankoh AJ. An overview of practical approaches for handling missing data in clinical trials. J Biopharm Stat 2009 Nov;19(6):1055-73.

(52) Eldridge SM, Ashby D, Kerry S. Sample size for cluster randomized trials: effect of coefficient of variation of cluster size and analysis method. Int J Epidemiol 2006 Oct;35(5):1292-300.

(53) Kerry SM, Bland JM. Unequal cluster sizes for trials in English and Welsh general practice: implications for sample size calculations. Stat Med 2001 Feb 15;20(3):377-90.

(54) Taljaard M, Donner A, Klar N. Accounting for expected attrition in the planning of community intervention trials. Stat Med 2007 Jun 15;26(13):2615-28.

(55) Ahn C, Hu F, Skinner CS. Effect of Imbalance and Intracluster Correlation Coefficient in Cluster Randomized Trials with Binary Outcomes. Comput Stat Data Anal 2009 Jan 15;53(3):596-602.

(56) Ahn C, Hu F, Skinner CS, Ahn D. Effect of imbalance and intracluster correlation coefficient in cluster randomization trials with binary outcomes when the available number of clusters is fixed in advance. Contemp Clin Trials 2009 Jul;30(4):317-20.

(57) Eldridge S, Cryer C, Feder G, Underwood M. Sample size calculations for intervention trials in primary care randomizing by primary care group: an empirical illustration from one proposed intervention trial. Stat Med 2001 Feb 15;20(3):367-76.

(58) Hoenig JM, Heisey DM. The abuse of power: The pervasive fallacy of power calculations for data analysis. The American Statistician 2001;55(1):19-24.

(59) Hill AB. The environment and disease: association or causation? Proc R Soc Med 1965 May;58:295-300.

Appendix A: PubMed/Medline Search Strategy

1. Delivery of Health Care [Mesh:noexp]
2. Practice Management, Medical [Mesh]
3. 1 or 2
4. Professional-Family Relations [Mesh]
5. Patient-Centered Care [Mesh]
6. Family Nursing [Mesh]
7. Family [Mesh]
8. Family/psychology [Mesh]
9. Patient Participation [Mesh]
10. Physician-Patient Relations [Mesh]
11. 4 or 5 or 6 or 7 or 8 or 9 or 10
12. Primary Health Care [Mesh]
13. Physicians, Family [Mesh]
14. Family Nursing [Mesh]
15. Family Practice [Mesh]
16. 12 or 13 or 14 or 15
17. 3 and 11 and 16

Appendix B: Methods paper for the original study

The Comparison of Models of Primary Care in Ontario (COMP-PC) study: methodology of a multi-faceted cross-sectional practice-based study

SIMONE DAHROUGE, WILLIAM HOGG, GRANT RUSSELL, ROBERT GENEAU, ELIZABETH KRISTJANSSON, LAURA MULDOON, SHARON JOHNSTON

ABSTRACT

Background: Many industrialized nations have initiated reforms in the organization and delivery of primary care. In Ontario, Canada, salaried and capitation models have been introduced in an attempt to address the deficiencies of the traditional fee-for-service model. The Ontario setting therefore provides an opportunity to compare these funding models within a region that is largely homogeneous with respect to other factors that influence care delivery. We sought to compare the performance of the models across a broad array of dimensions and to understand the underlying practice factors associated with superior performance. We report on the methodology grounding this work.

Methods: Between 2004 and 2006 we conducted a cross-sectional mixed-methods study of the fee-for-service model, including family health groups, family health networks, community health centres and health service organizations. The study was guided by a conceptual framework for primary care organizations. Performance across a large number of primary care attributes was evaluated through surveys and chart abstractions. Nested case studies generated qualitative provider and patient data from 2 sites per model along with insights from key informants and policy-makers familiar with all models.

Results: The study recruited 137 practices. We conducted 363 provider surveys and 5361 patient surveys, and we performed 4108 chart audits. We also conducted interviews with 40 family physicians, 6 nurse practitioners, 24 patients and 8 decision-makers. The practice recruitment rate was 45%; it was lowest in fee-for-service practices (23%) and in family health networks (37%). A comparison with all Ontario practices in these models using health administrative data demonstrated that our sample was adequately representative. The patient participation (82%) and survey scale completion (93%) rates were high.

Conclusions: This article details our approach to performing a comprehensive evaluation of primary care models and may be a useful resource for researchers interested in primary care evaluation.

Simone Dahrouge is the manager of research operations at the C.T. Lamont Primary Health Care Research Centre, the research arm of the Department of Family Medicine, Faculty of Medicine at the University of Ottawa, Ottawa, Ontario, Canada. **William Hogg** is a professor at the Department of Family Medicine, the Department of Epidemiology and Community Medicine, and the Institute of Population Health, University of Ottawa, and director of the C.T. Lamont Primary Health Care Research Centre. **Grant Russell** is an associate professor at the Department of Family Medicine and the Department of Epidemiology and Community Medicine at the University of Ottawa, and a clinician investigator at the C.T. Lamont Primary Health Care Research Centre. **Robert Geneau** is an adjunct professor in the Department of Family Medicine at the University of Ottawa and principal scientist at the C.T. Lamont Primary Health Care Research Centre. **Elizabeth Kristjansson** is a principal scientist at the Institute of Population Health, University of Ottawa. **Laura Muldoon** is a lecturer in the Department of Family Medicine at the University of Ottawa and a principal scientist at the C.T. Lamont Primary Health Care Research Centre. **Sharon Johnston** is an assistant professor at the Department of Family Medicine and a principal scientist at the C.T. Lamont Primary Health Care Research Centre, University of Ottawa.

Competing interests: None declared.

Funding source: Funding for this research was provided by the Primary Health Care Transition Fund of Ontario Ministry of Health and Long-Term Care. The views expressed in this report are the views of the authors and do not necessarily reflect those of the Ontario Ministry of Health and Long-Term Care.

Correspondence: Simone Dahrouge, Manager, Research Operations, C.T. Lamont Primary Health Care Research Centre, Élisabeth-Bruyère Research Institute, 43 Bruyère St., Ottawa ON K1N 5C8; sdahroug@scohs.on.ca

OPEN MEDICINE 2009 3(3):149-164

As a growing body of evidence reveals the importance of primary care to the health of populations, there is increasing interest in the efficient, effective and equitable delivery of these services. In response, many industrialized nations have initiated reforms in the organization and delivery of primary care with the aim of optimizing care delivery.[1] Primary care is funded in several different ways by different countries. Capitation funding provides a fixed annual sum to a practice for the care of each patient registered with that practice. Fee-for-service funding provides payment to a practice according to services delivered, such as patient consultations and type of care delivered. In a salaried service, the health care providers are employed and practice income is not dependent on the number of services provided or the number of patients served. Recently some countries have made efforts to introduce quality- or performance-related payments into existing payment structures.[2–4] There is little evidence to indicate which models of funding of primary care deliver better services, and international comparisons are difficult to interpret because differences are not confined to funding models.

The situation in Ontario, Canada, provides an excellent opportunity to compare funding models for primary care because the 3 major models described above have been used side by side in recent years. This enables comparisons to be made largely unconfounded by differences in gross domestic product, percent spending on health care, patient characteristics and professional training. Over the past 2 decades, Ontario has developed an array of diverse models of primary care delivery but little information on their comparative performance is available to guide further reform initiatives. In 2002, the government of Canada established the Primary Health Care Transition Fund, an $800-million commitment to help provinces and territories develop and sustain new approaches to primary health care delivery. In this article we report on the methodology of a mixed-methods practice-based study sponsored from this fund, the Comparison of Models of Primary Care in Ontario (COMP-PC). We studied fee-for-service (FFS) practices (including the traditional FFS model and reformed family health group model), a capitation-based system called health service organizations (HSOs), a model of multidisciplinary community health centres (CHCs) employing salaried physicians with a focus on community needs, and a relatively new model of physician-run group practices, the family health networks (FHNs), which incorporated extended-hour coverage, financial support for information technology and a blended remuneration formula of capitation, performance bonuses and fee for service.

Our aim was to measure the impact of funding models of primary care on patient self-reported quality of care and on provider adherence to recommended standards of care. In this article we detail the study design and the methods used for data collection. We describe how we categorized and sampled practices using different funding models, how we collected information on processes of care that might explain model differences and how we measured the outcomes of quality and adherence. This large study used a complex methodology that cannot be sufficiently described in associated articles. This article, therefore, serves as an elaboration of the methods that will be reported in a succinct form elsewhere.

Methods

Objectives. The objectives of the COMP-PC study were to describe 4 funding models (FFS, HSOs, CHCs and FHNs), to measure and compare the quality of primary care delivered and to better understand aspects of practice organization that may influence the health care experience of patients and the quality of care they receive. The process and outcome evaluation were theory based[5] and guided by a conceptual framework (Fig. 1).[6]

Design. The COMP-PC project was a cross-sectional mixed-methods study of primary care practices involving quantitative data collection and a nested qualitative case study using a subset of 2 sites per model. The Ottawa Hospital Research Ethics Board approved the study. Figure 2 summarizes the study sampling approach and eligibility criteria.

Study population. The study involved primary care practices, their providers and patients. We also interviewed key informants and policy-makers who had in-depth knowledge of each model.

Sample size. The study measured the performance of primary care practices across numerous outcomes. Because we expected the measure of performance in disease prevention to require the greatest number of measurements, it was used to estimate sample size. Performance in disease prevention was measured as the adherence to recommended guidelines for 6 manoeuvres (see Table 1, section 2.2). A patient's disease prevention score was the proportion of manoeuvres performed to manoeuvres for which he or she was eligible.

Sample size was calculated using a minimum clinically important difference of 0.5 standard deviation, with an alpha value of 0.05 and a beta value of 0.20, and was chosen to control for the family-wise error rate and variance of the cluster (cluster correlation coefficient of 0.2).[7] The basic unit of random selection was the prac-

See related article: Hogg W, Dahrouge S, Russell G, Tuna M, Geneau R, Muldoon L, Health promotion activity in primary care: performance of models and associated factors. Open Med 2009;3(3):165-173

tice. The recommendation that resulted from this calculation was to include data from 40 practices per model and data from at least 30 patients per practice. Owing to budgetary and time limitations, the number of practices was reduced to 35. We aimed to collect up to 50 surveys at each practice (instead of 30) to compensate for the possibility that surveys would not be adequately completed.

For the nested case study, we selected 8 practices (2 per model) from within the sites recruited for the cross-sectional study to allow for methodological and data triangulation.We stopped conducting interviews after wereached an acceptable level of data saturation for each model and for each category of respondent (providers, patients and key informants).

Study participants: practices

Eligibility. For practical reasons, we excluded practices in the far north of the province.[1] Over the course of the recruitment period, we noted that the majority of practices under the traditional FFS model had converted to family health groups (FHGs), a modified FFS model introduced as the study was getting underway. At the time of recruitment, the main difference between the FHG and the traditional FFS models was that FHG practices were required to register their patients and provide extended hours of service, for which they received additional compensation.[8] Three months before the end of recruitment a decision was made to include FHG practices within the traditional FFS group, and we endeavoured to enrol those FFS practices previously deemed non-eligible because they had converted to FHGs. In this document we refer to both models as FFS.

Consent to participate was required from at least half of the physicians and nurse practitioners in the organization. Practices were also required to have operated under their model for at least 1 year and provide general primary care services. Practices also provided consent to allow the study investigators to access the information related to their practice contained in health administrative databases housed at the Institute for Clinical Evaluative Sciences (ICES). Practices were considered a group if the individual providers shared at least 4 of the following 5 items or resources: office space, staff, expenses, patient records and on-call duties. Practices with different geographic locations (addresses) were considered separate even if they were linked in a network.[9]

Sampling strategies and recruitment. All of the CHC, HSO and FHN practices in Ontario and a randomly selected group of 197 FFS–FHG practices were invited to participate. Forty-two of these FFS–FHG practices were found to be not eligible, leaving 155 eligible FFS–FHG practices. For the nested case study, we used a typical case sampling strategy to select the sites.[10] Practice sites were invited to participate in this qualitative component if they typified the model to which they belonged in size and composition. Practices needed to be large enough to allow sufficient provider interviews to permit data saturation within that model. We recruited 1 urban and 1 rural practice from each model, with the exception of HSOs; 2 urban sites were selected for HSOs because these organizations are concentrated in urban areas. The sample base covered practices serving approximately 90% of the provincial population of 12.6 million at the time of sampling.

Study invitation materials were mailed to eligible practices. Follow-up was done through a combination of mailings, telephone calls and face-to-face visits. We also sought the support of the model's central organizational structure where one existed (i.e., CHCs and HSOs) in delivering study information and promoting participation.

Sites were offered C$2000 in recognition of the time required by professionals and administrative staff to participate in the study. An additional C$500 was paid to those practices participating in the qualitative component of the study. Recruitment and data collection took place from June 2005 to June 2006.

Study participants: providers

Eligibility. Physicians and nurse practitioners working at the practice were eligible to participate in the study if they had practised at that site for at least 1 year or 6 months, respectively; the participating site was the principal site of their clinical practice; the majority of their services were devoted to primary care; and the majority of their patients were over the age of 17 years.

Sampling strategies and recruitment. Practices were asked to invite all eligible providers to participate in the study and were informed that participation by at least half of the eligible providers was required for the practice to be included in the study; 363 providers participated. Practices electing to also participate in the qualitative component provided names of family physicians and nurse practitioners who were interested in interviews. For 2 sites with multiple providers, this process yielded only 2 providers. In these cases, snowball sampling was then used to recruit providers through the first contact.

Study participants: patients

Eligibility. Patients were eligible to complete the survey if they were patients of consenting providers, 18 years of age or older, not severely ill or cognitively impaired, not known to the survey administrator and able to communicate in English or French either directly or

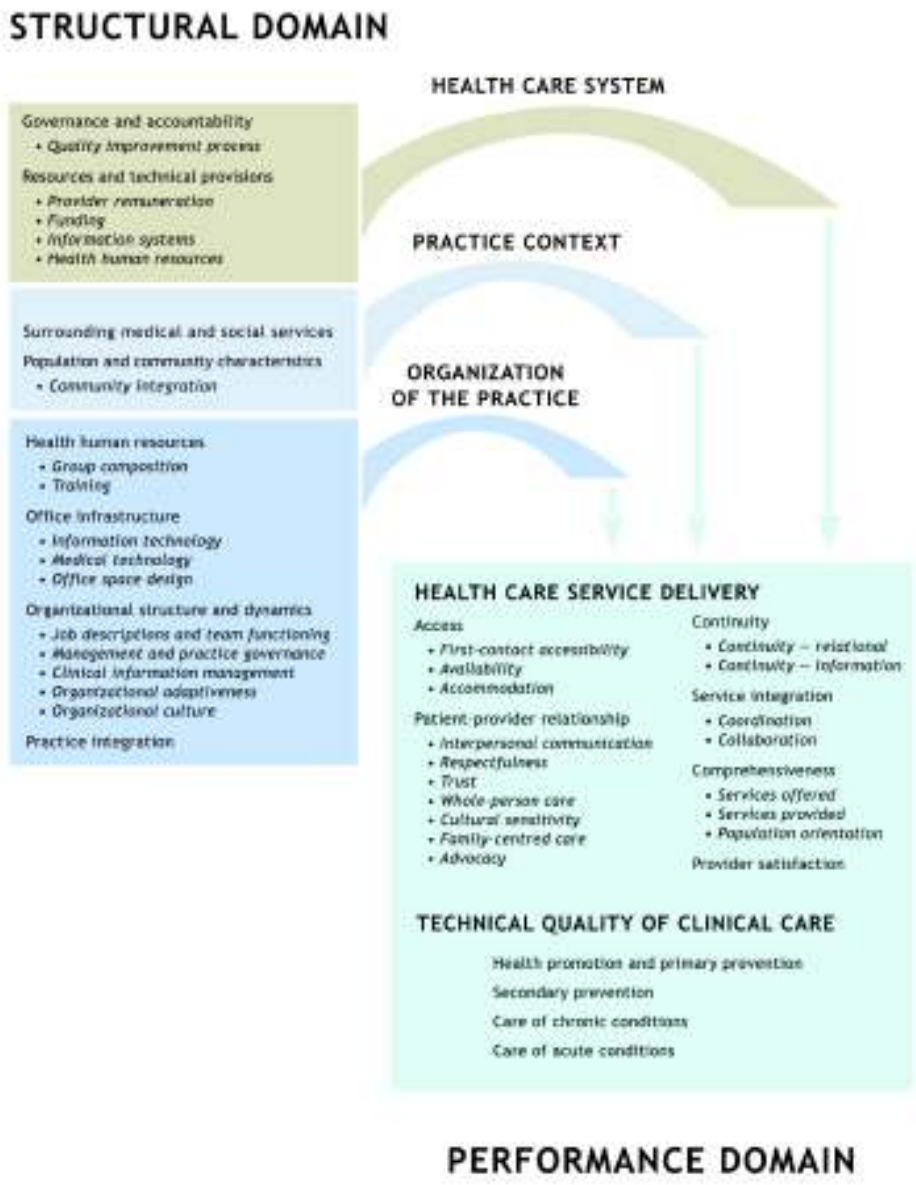


Figure 1: Conceptual framework for primary care organizations. Adapted from Hogg W, Rowan M, Russell G, Geneau R, Muldoon, L. A conceptual framework for primary care: the importance of a structural domain. *International Journal for Quality in Health Care* 2008;20(5):308-313. Used with permission of the journal and Oxford University Press.

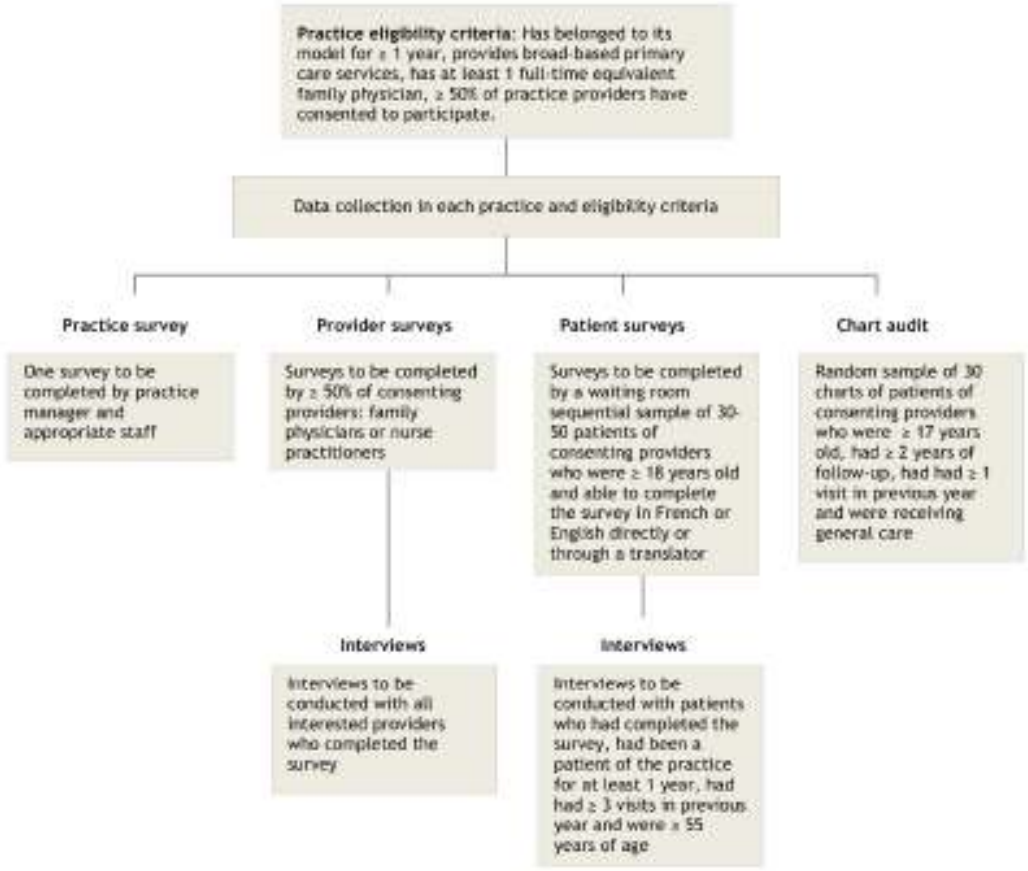


Figure 2: Practice-based study recruitement and eligibility flow chart. Two sites per model (a total of 8 practices) were selected for the in-depth qualitative assessment (the interview phase). In these practices, we interviewed a total of 40 family physicians, 6 nurse practitioners and 24 patients.

Table 1: Scales and indicators

	Attribute	Data source Pr	Pt	C	Scales and indicators (source)
STRUCTURAL DOMAIN – ORGANIZATION					
1	**Health care system**				
1.1	Governance and accountability				Qualitative evaluation
1.2	Resources and technical provisions	X			Provider remuneration (IH)
2	**Practice context**				
2.1	Surrounding medical and social services	X			Types of and distance to institutions and professionals servicing the community (IH)
		X	X	X	Patient sociodemographic and economic information (adapted from PCAT) and patient health status (PCAS)
2.2	Population and community characteristics	X			Team structure and sociodemographic characteristics (IH)
3	**Organization of the practice**				
3.1	Health human resources	X			Provider sociodemographic information (IH) Practice staffing and structure (IH)
3.2	Office infrastructure	X			Information technologies implemented (adapted from National Physician Survey)[1]
3.3	Organizational structure and dynamics	X			Duration of operation as a practice and within its model (IH) Roles and responsibilities at the site and extent of sharing resources (adapted from National Physician Survey)[1] Duration of regular visit, hours of operation, provider payment structure, revenues and operation costs (IH) Quality control audits
				X	Chart organization (IH)
PERFORMANCE DOMAIN – OUTCOME					
1	**Quality of health care service delivery**				
1.1	Access	X	X		First contact accessibility scales (PCAT)
			X		First contact utilization scale (PCAT) Duration of today's consultation (IH)
		X			Practice accepting new patients (IH) Duration of routine visit (IH) Hours of operation and on-call hours (IH) Disability access (IH)
1.2	Patient-provider relationship		X		Humanism scale[3] Trust scale[3] Wait time in clinic (IH)
		X	X		Cultural competency scales (PCAT) Family centredness scales (PCAT)

Attribute		Data source Pr	Pt	C	Scales and indicators (source)
1.3	Continuity		X		Ongoing care scale (PCAT) Relationship with practice and provider (IH)
1.4	Service integration	X			Coordination scale (PCAT) Coordination: information system scale (PCAT) Extent of sharing resources (adapted from National Physician Survey)[1]
1.5	Comprehensiveness	X			Services offered (PCAT) Community orientation scale: reach out (PCAT) Community orientation scale: needs assessment (PCAT) Community orientation scale: monitor (PCAT)
		X	X		Community orientation scale (PCAT)
			X		Reason for visit (IH)
1.6	Provider satisfaction	X			Provider satisfaction scale (National Physician Survey)[1] Remuneration preferences (IH)
2	**Technical quality of clinical care delivery**				
2.1	Chronic disease management			X	Manoeuvres performed in adherence with recommended guidelines: • Coronary artery disease: aspirin, beta blocker, statins • Diabetes: HbA_1C test frequency, angiotensin-converting enzyme inhibitor or angiotension receptor blocker, seen by an ophthalmologist or optometrist, feet checked or patient referred to a chiropodist or podiatrist • Congestive heart failure: angiotensin-converting enzyme inhibitor or angiotension receptor blocker, beta blocker Intermediate clinical outcomes: • Hypertension: blood pressure results • Diabetes: HbA_1C result
2.2	Disease prevention			X	Manoeuvres performed in adherence with recommended guidelines: • High risk for influenza: influenza vaccine • 50 years of age or older: colorectal cancer screening by sigmoidoscopy or hemoccult stool test • Females 50–69 years of age: breast cancer screening by mammography and clinical examination • Females under 60 years of age: cervical screening • 65 years of age or older: clinical hearing examination • 65 years of age or older: screening for visual impairment
2.3	Health promotion		X		Subjects discussed at that visit in adherence with recommended guidelines: • Healthy foods and unhealthy foods • Home safety, such as getting and checking smoke detectors and storing medicines safely • Family conflicts • Exercise • Check and discussion of the medications the patient is taking • Tobacco, smoking • Alcohol consumption • Fall prevention

Attribute		Data source Pr	Pt	C	Scales and indicators (source)
2.4	Management of acute conditions			X	Appropriate prescription of antibiotic in adherence with recommended guidelines: • Sore throat • Urinary tract infection

IH = questions developed in house, PCAT = Primary Care Assessment Tool, PCAS = Primary Care Assessment Survey.

This table shows the indicators and scales used in the quantitative evaluation of the models. Assessment of the various attributes of the structural domain was principally informed by the qualitative evaluation. The performance domain was measured through surveys and chart abstractions (Pr = practice or provider survey, Pt = patient survey, C = chart). Most health service delivery attributes were measured using the PCAT scales. The instruments were supplemented with questions designed specifically for this study. The technical quality of care delivery was assessed by comparing the extent to which the care delivered was consistent with recommended guidelines for the management of patients in primary care.

1. College of Family Physicians of Canada. 2002. Updated data release of the 2001 National Family Physician Workforce Survey. www.cfpc.ca/local/files/Programs /Janus%20project/NFPW52001_Final_Data_Release_rev_en pdf. [Accessed 7 Mar 2007]
2. Hauck FR, Zyzanski SJ, Alemagno SA, Medalie JH. Patient perceptions of humanism in physicians: effects on positive health behaviors. *Fam Med* 1990;22(6):447-452.
3. Hall MA, Zheng B, Dugan E, Camacho F, Kidd KE, Mishra A, et al. Measuring patients' trust in their primary care providers. *Med Care Res Rev* 2002;59(3):293-318.

Table 2: Study participation rate by model

Variable	CHC	HSO	FHN	FFS	Overall
Practices					
Approached, no.	53	69	104	197	423
Eligible, no.	51	65	94	155	365
Participated, no.	35	32	35	35	137
Response rate, %	69	49	37	23	45
Providers					
Participated,* no.	182	42	81	58	363
Patients					
Eligible, no.	1591	1590	1583	1758	6522
Participated, no.	1219	1273	1494	1375	5361
Response rate, %	77	80	94	78	82
Chart abstraction	1050	958	1050	1050	4108

CHC = community health centre, HSO = health service organization, FHN = family health network, FFS = traditional fee-for-service and family health group.

* Provider recruitment was relinquished to the practice manager. We did not track the actual participation rate other than to ensure it was at least 50%.

through a translator. Patients participating in the qualitative component of the study were also required to have been patients of the practice for at least 1 year and to have attended at least 3 appointments. We gave preference to those 55 years of age or older.

Sampling strategies and recruitment. Following a prepared script, receptionists introduced the study and handed an invitation letter to all patients presenting for their appointment on the day of survey administration. Using another prepared script, the survey administrator provided more detailed information about the study, verified whether the patient met the full set of eligibility criteria and invited eligible patients to participate. In practices participating in the qualitative component of the study, the survey administrator invited patients who had completed surveys to take part in an in-depth interview at a later date, until 6–8 agreed.

Chart audit

Eligibility. Chart abstraction was limited to the charts of regular patients of consenting care providers who were 17 years of age or older at the time of their last visit and had at least 2 years of information, with at least 1 visit in the previous year. Patients were excluded if they had died or had left the practice in the previous 2 years, had used the practice for specialized services only (e.g., foot care), were known to the chart abstractor or were staff members of the practice.

Random selection. In practices with paper-based charting, the total length of the shelves containing the charts was divided into 60 "similar distance" sections, and the fifth chart from the start of each section was retrieved for evaluation. In practices with electronic medical records, a random-number generator produced a list of 100 practice patients. In each case the chart abstractor reviewed eligibility sequentially until 30 eligible charts were identified for review.

Data collection tools. We used a theory-based evaluation framework to identify the dimensions of care that should be addressed and to help select the tools used for the evaluation.[5] The process involved a review of the literature and consultation with stakeholders and experts in the field to develop the theory underpinning the approach. As a result, we developed a conceptual framework that identified key areas to measure;[6] established program logic models for each practice model that provided a detailed visualization of the link between organizational attributes, activities and performance; and produced a mapping document to guide the tool selection.

Quantitative component. The quantitative data collection tools comprised 3 surveys and a chart abstraction form. The surveys were modified from the adult edition of the Primary Care Assessment Tool (PCAT), full or abridged version. The PCAT is an instrument developed to measure the quality of primary care services. The full version of the PCAT was validated in 2001.[11,12] We selected this tool because of the high degree of congruency between the dimensions it addresses and those set out in our conceptual framework and because the instrument allows the perceptions of patients and providers to be measured. To maintain the validity of the original tool, which was developed in the US, modifications were kept to a minimum and primarily reflected the differences in context between the US and Ontario settings. To minimize the burden on providers in group practices, a subset of questions from the provider survey addressing practice factors common to all of the providers in a given practice was moved to a practice survey.

The content of the PCAT was mapped to the dimensions of the conceptual framework, and where deficiencies were noted the tool was supplemented with questions from the National Physician Survey and other studies[9,13-15] or with questions developed by the investigators. Copies of the surveys are available from the authors upon request. Details of the scales and indicators used in this evaluation are shown in Table 1.

Practice survey. The practice survey was divided into 3 sections. The first focused on the description of the practice environment including the setting, hours of operation, availability of medical and social services in the surrounding area and accessibility for disabled persons. The second section contained questions that measured performance (see Table 1). The third section captured various practice attributes, including governance, team structure, extent of information technology adoption and economic information (e.g., sources of income, salaries and operating costs).

Provider survey. The provider survey was divided into 2 sections. The first section contained questions measuring the provider's perception of practice performance on several dimensions of health care service delivery (see Table 1). The second section captured provider demographic information, information on their work setting and socio-economic information.

Patient survey. The patient survey was divided into 2 sections. The first section was completed in the waiting room before the visit with the provider. This section captured patient sociodemographic and economic information and elicited the patient's experience concerning a broad range of dimensions of health care service delivery as shown in Table 1. The second section, completed after the appointment with the provider, took

less than 5 minutes to answer and captured visit-specific information, including waiting time, visit duration and measures of activities related to health promotion.

The survey was developed in English and translated to French through an extensive iterative translation process. The French version was validated against the English version on a sample of 120 bilingual individuals.[15] We made the tool available in French and English only and relied on the services of translators to reach patients who spoke neither language.

Chart audit. The chart audit forms captured 4 thematic areas: patient demographic information; visit activities, including referrals, prescriptions and orders; chart organization; and measures of performance of technical quality of care, including prevention, chronic disease management and acute disease management. We evaluated performance of technical quality of care by comparing the care provided with established guidelines for prevention, chronic disease management and acute disease management.

Qualitative component. We used the conceptual framework to define the topics and questions to be covered during qualitative data collection. At the case study sites at least 2 physicians and at least 1 nurse practitioner (if available) were interviewed. The interview guide for providers contained questions about the influence of organizational characteristics (e.g., remuneration scheme), processes (e.g., teamwork, inter-professional collaboration) and clinical routines on service delivery. The interview guide for patients focused on their experience with the practice associated with the dimensions of accessibility, continuity, coordination and comprehensiveness of care. The interviews with key informants focused on qualitative comparisons of the 4 models studied in relation to broad issues such as governance, accountability and performance measurement in primary care.

Quality control. All tools were piloted before the start of the study. A full description of the piloting process can be found in Appendix 1. Data entry verification was performed for all 4 tools, and the accuracy with which the results of the practice and provider survey were recorded was enhanced by double data entry. Chart audit validation was performed twice during the study. At each verification, chart abstractors were informed of their errors and received additional focused training then and throughout the study. Data were exported into SPSS and verified for internal consistency, missing information and outliers. Queried data were verified against the hard copy of the data collection tools. The validity of the qualitative findings was verified using naturalistic inquiries.[16] We also engaged in member-checking procedures to establish the credibility of our findings. Finally, the use of data triangulation techniques increased the construct validity of our measures for the performance domain (for both the quantitative and qualitative components). Additional details concerning the quality control processes are available in Appendix 1.

Study processes. This study involved a wide range of personnel from various backgrounds over a 3-year period and required significant organizational preparation. Details of the study team composition and study processes are available in Appendix 2.

Stakeholder advisory meeting. A stakeholder advisory committee comprised of 2 members from each model, Ministry of Health and Long-Term Care representatives, a community member and study team members met twice during the study. The committee's goals were for its members to serve as conduits between their representative group and the study team, to ensure transparency of the study process, to guide the evaluation plan and interpretation of results, and to participate in outcome dissemination.

Planned analyses. The study captures 2 types of data, 1 describing the practice structure and the other the practice performance (see Table 1). The study will use multi-level analyses to compare the performance of the models studied across the performance dimensions. It will also rely on the large number of structural attributes described for each practice to assess their impact on performance by evaluating their association with better performance. For example, we will evaluate whether a difference in first contact accessibility exists between models and then identify the components of the practice structure that are associated with better first contact accessibility across all models. In these analyses, provider information will be aggregated to the practice level, and patient level information (from surveys and chart abstraction) will be linked to the practice and provider data, allowing a hierarchical approach to data analysis accounting for intra-cluster correlations.[7] We captured measures of the quality of health service delivery as well as measures of the technical quality of care in the sample practices. Our analyses will also allow us to understand the relationship between the 2 within a practice.

Results

The study was successful in recruiting its intended number of practices (35) in all practice types except HSOs (32) (Table 2) and involved 8 practices in the qualitative evaluation. FFS–FHG practices were the most difficult ones to recruit (participation rate of 23%). We compared the profiles of the recruited family physicians with the profiles of all Ontario family physicians practising in these models to determine if there was selection bias related to practice refusal or provider

Table 3: Practice representativeness by model

Characteristic	FFS		FHN		CHC		HSO	
	Study *n* = 58	ICES *n* = 9055	Study *n* = 80	ICES *n* = 590	Study *n* = 108	ICES *n* = 186	Study *n* = 42	ICES *n* = 165
Provider demographic profile								
Male, %	52	66	60	65	42	51	74	73
Years since graduation, mean	22	26	23	22	19	19	29	28
Foreign trained, %	17.2	21.8	2.5	10.5	9.3	9.7	14.3	9.1
Rural, %	12	10	21	33	–	–	–	–
Provider work profile*								
Total visits, no.	5873	5389	4893	5329	–	–	–	–
Emergency visits, no.	265	199	180	331	–	–	–	–
Office visits, no.	5201	4651	4145	4279	–	–	–	–
Total payments (x 1000)	$192	$188	$140	$162	–	–	–	–

The sample sizes in the column headings represent the number of providers.

FFS = traditional fee-for-service and family health group, FHN = family health network, CHC = community health centre, HSO = health service organization, ICES = Institute for Clinical Evaluative Sciences.

* To create this profile, virtual patient rosters were built in the administrative databases in which patients were assigned to a practice if at least 50% of the billing associated with their care was submitted by a provider at that practice. These workload data were based on the period from Apr. 1, 2004, to Mar. 31, 2006.

Table 4: CHC patient representativeness

Sociodemographic factor	Study	CHC database
Age, yr (mean)	48.6	46.2
Female, %	71	50
Born in Canada, %	69	67
Duration in Canada, yr (mean)	18	13
Education, %		
No formal education	1	10
Primary or secondary	56	55
Post-secondary	43	36
Household income, %		
$0–$14 900	25	37
$15 000–$34 900	26	23
> $35 000	49	40
Single-person household, %	16	14
Insurance coverage, %		
Insured in Ontario (includes insured in Canada)	92	91
Uninsured	8	9

CHC = community health centre. Fourteen CHC practices participated in this evaluation. The table shows the sociodemographic factors of all patients in these 14 practices and of the patients participating in the study from these same practices.

Table 5: Extent of scale completion

Scale	% evaluable Pr	Pt
Access		
First contact accessibility scales	100	94
First contact utilization scale	–	99
Patient-provider relationship		
Humanism scale	–	99
Trust scale	–	98
Cultural competency scales	99	89
Family centredness scales	100	96
Continuity		
Ongoing care scale	–	99
Service integration		
Coordination scale	100	–
Coordination: information system scale (PCAT)	100	–
Comprehensiveness		
Services offered (PCAT)	100	–
Community orientation scale: reach out	97	–
Community orientation scale: needs assessment	96	–
Community orientation scale: monitor	98	–
Community orientation scales	100	72
Provider satisfaction		
Provider satisfaction scale	100	–
Technical quality of clinical care delivery		
Health promotion	–	91
Overall average	99	93

Pr = scale included in the provider or practice survey, Pt = scale completed by the patient, PCAT = Primary Care Assessment Tool.

self-selection. We relied on the information contained in the physician workforce database and in the Ontario Health Insurance Plan (OHIP) billing database housed at ICES. The former allowed evaluation of provider demographic profiles, and the latter provided billing parameters that allowed us to compare the FFS–FHG and FHN practices only (these models rely on Ministry of Health and Long-Term Care billing for their remuneration). These comparisons showed that our sample is broadly representative for all characteristics measured in these databases (Table 3).

We compared the sociodemographic information of the CHC patients participating in the study with that of all CHC patients listed in the CHC practice electronic patient registration database to evaluate whether there was systematic bias in the selection of respondents from the CHCs (Table 4). CHC is the model most likely to serve individuals who are housebound or have language barriers and therefore less likely to have been reached in this study than patients from the other practice types. As anticipated, the waiting room sample was older and more likely to be female than the overall practice population, reflecting the profile of those who make more use of primary care services. The study sampling was not successful in reaching individuals without a formal education and those with lower income.

Survey questionnaires were not modified after the start of the study. All practices and all but 2 consenting providers completed the survey. The overall patient participation rate was 82%, with most scales adequately completed for evaluation (Table 5).

Discussion

We measured performance across a large number of primary care attributes to obtain a comprehensive picture of status of family care in Ontario. We evaluated dimensions of health service delivery and technical quality of care in the same practices. The study was complex and care was taken to ensure the quality of the data collected and to minimize disruption to the practices. At the study onset, much work was invested in ensuring that appropriate evaluation tools were used. Throughout the study, we focused on enhancing practice and patient recruitment, establishing dependable processes for data collection, verifying data quality and training and supporting personnel.

The study was successful in collecting data from 137 primary care practices for a multi-dimensional evaluation. The limitations of this mixed-methods study stem largely from the problems inherent in cross-sectional and survey-based studies. These include participant selection bias and the inability to infer causation from observed associations. Other study-specific factors are discussed below.

Sample selection. Sample selection was limited by our ability to identify all practices within a model, the geographic boundaries we established for data collection and the fact that patient recruitment was limited to those attending the practice. There was no accessible central source of reliable practice lists within each model, except for CHCs. In addition, late in 2004 the Ontario Ministry of Health and Long-Term Care instituted a new model of care, the FHG, to which FFS practices could transition. We initially excluded FHG practices, but FFS practices converted to this new model quickly; by early 2006 most FFS practices had become FHGs and it became evident that the great majority would transition by the year end. As a result, 3 months before recruitment was terminated, a decision was made to include the FFS practices that had transitioned to FHGs. Although a concerted effort was made to return to those practices initially deemed ineligible because they had converted into an FHG, not all attempts were successful, so we cannot ignore this potential source of bias toward late adopters within this subset.

The geographic boundaries set by the study resulted in the exclusion of the most northern territories of the province. These areas serve a more marginalized population living under very different conditions and for whom the experience of primary care services is not reflected by the study sample. Our study's findings cannot be extrapolated to that group.

Finally, we chose to administer the patient survey to those patients visiting the practice on a given day. This face-to-face approach is expected to have enhanced our response rate (compared with what might have been expected with a telephone or mailed questionnaire approach) but resulted in an overrepresentation of those more likely to frequent the practice. Therefore, the sample does not represent the general practice population, nor did it reach housebound patients. Rather it is weighted, perhaps appropriately so, by the frequency of visits.

In contrast, the chart-based assessment of the technical quality of care was based on a random selection of records so that the results could be generalizable to the practice level. An alternative strategy would have been to review the charts associated with the patients surveyed. Although that approach would have allowed the relationship between the quality of health service delivery and technical quality of care to be assessed at the individual patient level, the estimates of care level would have been biased toward those attending the practice more frequently.

Data. Although the original PCAT tool had been validated,[12] for some scales we relied on the nonvalidated abridged version of a validated scale. We made the tool available in 2 languages only (French and English) and used the services of translators to reach patients who spoke neither of these languages. Although we felt it was essential to capture the essence of the experience of patients from linguistic minority groups, the use of an intermediary allows for biases or inconsistencies to be introduced during the translation process.

Ideally, the selection of practices for the case study would have been informed by the results of the quantitative surveys concerning the quality-of-care indicators. This would have allowed us to select negative or deviant cases within each model for in-depth analyses. However, because of time constraints, sites were invited to participate in both components (quantitative and qualitative) of the onset of the study.

Participation. This study was conducted at a time when Ontario primary care practices were saturated with government-sponsored studies, which likely contributed to the suboptimal participation rate. The practice response rate was best in models from which we obtained support from their central organizational group (CHC and HSO). Despite lower participation rates in FFS–FHG and FHN practices, comparative data suggest that the study population was adequately representative. All but 1 scale had completion rates of 94% or higher.

We compared the study patient population with the general practice population in CHCs and found that CHC participants were older, more likely to be female, had completed a higher level of education and had a higher income than the general CHC population. In Canada older people, women and people with higher socio-economic status are more likely to visit their family physician, and thus these differences between the CHC patients surveyed and those served in CHCs may be related to our waiting room sampling approach rather than participation bias.[17]

Conclusions

This is the first comprehensive pan-Ontario evaluation of models of primary care. The breadth of data collected will allow an in-depth description of the practices belonging to each model type. An evaluation of the practice factors (organizational features and practice attributes) associated with better performing practices should help inform policy-makers about optimal features in primary care practices and shoud help inform practice managers about how best to structure their practices to serve their disadvantaged patients. This article may also be useful to researchers interested in investigating issues related to quality of care and organizational performance in primary care.

Contributors: Simone Dahrouge participated in finalizing the study methodology, managed the quantitative component and was the principal writer of the manuscript. William Hogg conceived the project, oversaw the data collection and analysis and participated in all phases of the writing. Grant Russell helped implement the study, worked on finalizing the methodology and contributed to the writing and editing of the manuscript. Robert Geneau described the qualitative methods used in the study and reviewed all manuscript drafts. Elizabeth Kristjansson participated in editing and reviewing manuscript drafts. Laura Muldoon conceived the study and oversaw its implementation and participated in the writing of the manuscript. Sharon Johnston helped guide the analysis and participated in the writing. All of the authors approved the final version of the manuscript.

REFERENCES

1. Rosenthal MB. Beyond pay for performance — emerging models of provider-payment reform. *N Engl J Med.* 2008;359(12):1197–1200.
2. Buetow S. Pay-for-performance in New Zealand primary health care. *J Health Organ Manag.* 2008;22(1):36–47.
3. Campbell S, Reeves D, Kontopantelis E, Middleton E, Sibbald B, Roland M. Quality of primary care in England with the introduction of pay for performance. *N Engl J Med.* 2007;357(2):181–190.
4. Pink GH, Brown AD, Studer ML, Reiter KL, Leatt P. Pay-for-performance in publicly financed healthcare: some international experience and considerations for Canada. *Healthc Pap.* 2006;6(4):8–26.
5. Rowan MS, Hogg W, Labrecque L, Kristjansson EA, Dahrouge S. A theory-based evaluation framework for primary care: setting the stage to evaluate the Comparison of Models of Primary Health Care in Ontario (COMP-PC) project. *Can J Program Eval.* 2008;23(1):113–140.
6. Hogg W, Rowan M, Russell G, Geneau R, Muldoon L. Framework for primary care organizations: the importance of a structural domain. *Int J Qual Health Care.* 2007;20(5):308–313.
7. Baskerville NB, Hogg W, Lemelin J. The effect of cluster randomization on sample size in prevention research. *J Fam Pract.* 2001;50(3):W241–W246.
8. Ontario Medical Association*Family health groups (FHGs): Frequently asked questions.* Toronto: The Association: 2007.
9. College of Family Physicians of Canada*Updated data release of the 2001 National Family Physician Workforce Survey.* 2002 [accessed 7 Mar 2007].
10. Patton MQ. *Qualitative research and evaluation methods.* Thousand Oaks (CA): Sage Publications, Inc: 2002.
11. Starfield B. *Adult primary care assessment tool—expanded version.* Boston: Primary Care Policy Center, Johns Hopkins University School of Hygiene and Public Health: 1998.
12. Shi L, Starfield B, Xu J. Validating the adult primary care assessment tool. *J Fam Pract.* 2001;50(2):E1.
13. Hauck FR, Zyzanski SJ, Alemagno SA, Medalie JH. Patient perceptions of humanism in physicians: effects on positive health behaviors. *Fam Med.* 1990;22(6):447–452.
14. Hall MA, Zheng B, Dugan E, Camacho F, Kidd KE, Mishra A, et al. Measuring patients' trust in their primary care providers. *Med Care Res Rev.* 2002;59(3):293–318.
15. Haggerty J. Centre de recherche du Centre hospitalier de l'Université de Montréal (CHUM)*Accessibility and continuity of primary care in Quebec. Annex 2: Primary Care Assessment Questionnaire.* 2004 [accessed 14 Aug 2009].
16. Lincoln YS, Guba EG. *Naturalistic inquiry.* Newbury Park (CA): Sage Publications, Inc: 1985.
17. Seale C. *The quality of qualitative research.* London: Sage Publications, Inc: 1999.
18. Nabalamba A, Millar WJ. Going to the doctor. *Health Rep.* 2007;18(1):23–35.

Citation: Dahrouge S, Hogg W, Russell G, Geneau R, Kristjansson E, Muldoon L, Johnston S. The Comparison of Models of Primary Care in Ontario (COMP-PC) study: methodology of a multifaceted cross-sectional practice-based study. *Open Med* 2009;3(3):149-164

Published: 1 September 2009

Appendix 2: Study processes

Two goals directed our study process: data quality and minimal practice disruption.

Data quality

Personnel training. The survey administrators received a half-day of training at a central location and were then paired with an experienced survey administrator for 2-3 days of fieldwork at 1 practice. The chart abstractors received 2 days of training at a central location and then carried out 1 day of fieldwork with an experienced chart abstractor. Each group was guided by a detailed instruction manual. Data collectors were also provided with a toll-free telephone number for the project team so that they could call if they had any questions or needed to report problems encountered in the field. Instruction manuals were revised periodically to reflect new information and were re-disseminated to the data collectors.

Data collection processes. At the first visit to the practice, the chart abstractor met with the office manager (and, when possible, the participating providers) to distribute and review the content of the practice and provider surveys and to offer assistance in interpreting the questions. If a survey was not completed during the data collection period in the practice, it was left with the respondent together with a cover letter and a self-addressed, postage-paid return envelope. A research assistant telephoned non-responders after 2 weeks, and, when required, this was followed by the mailing of a second (and, if necessary, third) copy of the survey package. The site received financial compensation only when all surveys had been returned and data collection completed. To increase the rate of completion of patient surveys, the survey administrators were available to answer patient questions and ensure that patients leaving the office completed the post-visit survey.

Chart abstractors were required to familiarize themselves with the charting system of each practice and inquire about all potential sources of clinical information, including electronic and paper-based medical records, registries of influenza vaccinations, medication lists and laboratory results.

All patients and providers participating in semi-structured interviews had first completed the survey. Our early access to quantitative data allowed us to customize to some extent the interview guide for each respondent. The providers' interviews focused on interrelationships between the organizational structures and processes, the practice context and the various dimensions of quality of care. The interviews with patients explored their experience receiving health care whereas those with key informants emphasized macro level issues such as governance and accountability. The average interview duration was 90 minutes.

Data entry. We used a web-based clinical data management tool (TrialStat Corporation, Ottawa, Ont.) to store all quantitative data. The customized electronic data capture forms contained rules for data entry validation (ranges, missing information and internal consistency [i.e., congruence between the data entered in related fields]) so as to minimize data entry errors. The survey administrators and chart abstractors entered the results of the surveys and chart audits, respectively, into the system from remote locations. Variable fields, labels and data were then exported directly into SPSS (SPSS Inc., Chicago, Ill.) for analysis. Data entry validation (targeting all chart abstractors and survey administrators) was performed by a research associate. All qualitative interviews were transcribed verbatim using Microsoft Word and were then validated and imported into N6 (QSR International, Doncaster, Victoria, Australia) for analysis.

Minimum disruption to the practice

To minimize disruption to the practice and to ensure a seamless effort, the data collectors received relevant information for each site, including the type of facility, contact information, participating providers and the best day and time to call. The chart abstractor and survey administrator coordinated the logistics of their data collection efforts before contacting the site. One team member was assigned to be the point of contact with the practice, and the 2 team members maintained contact with each other throughout the data collection period. Survey administration and chart abstraction required an average of 31 and 20 hours per practice, respectively.

Appendix 1: Quality control processes

Tool piloting

Drafts of the surveys were reviewed and piloted iteratively by members of the study team until general consensus was reached about tool readiness. External piloting of the surveys and chart audit took place between July and October 2005 and involved 6 practices in the Ottawa area: 2 FFS practices, 2 FHGs, 1 FHN and 1 CHC. The practices were recruited sequentially, allowing for adjustments to be made to the study tools in response to the results from the previous site piloted. At each site 1 practice survey was completed, 30 patients were surveyed and 30 charts were reviewed. In total, 18 consenting physicians completed the provider survey.

The piloting process identified a number of issues that allowed us to refine the chart audit, to clarify some survey questions and to streamline the process. Most of the changes were to the questions that had been added to the instrument by the study team. We modified a validated scale only when absolutely necessary. Smaller numbers of concerns were raised at successive iterations of the tools; the iterative process was stopped when no new issues were identified. Two of the pilot sites (1 CHC and 1 FHN) were also visited by the qualitative researchers to validate the provider and patient interview guides.

Validation of survey data entry

Survey administrators administered the patient surveys and entered the data into a web-based program. In certain sites, they also recruited patients for the qualitative component. Chart abstractors were responsible for distributing the provider and practice surveys and performing the chart audit and its web-based data entry. Shortly after we initiated data collection, a research associate performed duplicate data entry for patient surveys and chart audits for 8 sites to estimate data-entry error rates for all chart abstractors and survey administrators. Error rates were 1.3%, 1.4%, 4.4% and 0.33% for patient, provider and practice surveys and chart audits, respectively. A substantial proportion of the discrepancies observed in the survey data related to the assignment of "0" by the survey administrators in numeric fields where no data had been recorded on the form. Detailed feedback and instructions were provided to all personnel involved in data entry. To ensure that high-quality data were collected, at the end of the study the data from all provider and practice surveys were re-entered by another research associate (double data entry) and errors were corrected. A final random verification of the data entry for the patient surveys found that the overall error rate had dropped to 0.5%.

Chart audit validation

Seven chart abstractors performed chart abstractions at 137 practices. Because this process is rather complex and prone to human error, a review process was set up to ensure the quality and consistency of data extraction. The abstractors were informed that validation would take place throughout the study and were required to maintain for that purpose a list of the charts they had reviewed at each practice. Validation involved duplication of the entire data extraction for 8 charts. We defined levels of error and took action according to the extent to which these errors were observed. An error that led to the failure to recognize eligibility for more than one manoeuvre (e.g., age miscalculated, chronic disease not recognized) was considered most significant (level 1). A level 2 error was defined as a missing visit record or incorrect attribution of eligibility that led to a single manoeuvre or sub-question being missed. All other coding errors were considered minor. The presence of at least one level 1 error or two level 2 errors was considered a significant problem and led to the validation of all the remaining charts that had been reviewed at that practice. Errors encountered were corrected on the data collection form. The chart abstractors were informed of their errors, and this opportunity was used for further general training. The abstractors also received ongoing training and support throughout the chart abstraction process.

The first round of validation was performed very shortly after the start of the study and involved the first 2 sites completed by each of the 7 chart abstractors. At that time, level 2 errors (at least 2) were identified in the charts of 2 abstractors. The second round of validation occurred during the winter of 2006. At that time, 6 abstractors were active; again 2 sites were randomly selected for each abstractor and the same procedure was followed. No significant problems were encountered.

Qualitative component

We used several procedures to ensure the validity of the qualitative findings. We adopted the criteria defined by Lincoln and Guba for naturalistic inquiries.[16] First, we offered a detailed description of each site and of each primary health care model. Providing a thick description is one of the key characteristics leading to the transferability of qualitative results to other contexts.[17] Second, we asked external peer reviewers to critique and challenge our research design, analytic strategy and interpretation of findings to increase the level of dependability of our study. We also engaged in member-checking procedures to establish the credibility of our findings by sending our case study reports to members of the 8 participating sites. The key informants were also asked to review a draft copy of the final report. Finally, the use of data triangulation techniques increased the construct validity of our measures for the performance domain (for both the quantitative and qualitative components). We blended qualitative and quantitative approaches to answer the research questions and reach consistent and valid conclusions. This approach also allowed us to verify the validity of the constructs addressed in the quantitative survey.

Appendix C: Questions making up the family-centeredness scale on the provider survey.

	DEFINITELY	PROBABLY	PROBABLY NOT	DEFINITELY NOT	NOT SURE, DON'T KNOW
1. Does your office ask the patients about *their* ideas and opinions when planning treatment and care for the patient or family member?	❑	❑	❑	❑	❑
2. Does your office ask about illnesses or problems that might run in the patient's families?	❑	❑	❑	❑	❑
3. Is your office willing and able to meet with family members to discuss a health or family problem?	❑	❑	❑	❑	❑

4. How often are each of the following included as a routine part of your health assessment?

	DEFINITELY	PROBABLY	PROBABLY NOT	DEFINITELY NOT	NOT SURE, DON'T KNOW
Use of:					
a. Family genograms, family APGAR	❑	❑	❑	❑	❑
Discussion of:					
b. Family health risk factors (e.g. genetics)	❑	❑	❑	❑	❑
c. Family economic resources	❑	❑	❑	❑	❑
d. Social risk factors (e.g. loss of employment)	❑	❑	❑	❑	❑
e. Living conditions (e.g. working refrigerator, heat)	❑	❑	❑	❑	❑
f. Health status of other family members	❑	❑	❑	❑	❑
g. Parenting	❑	❑	❑	❑	❑
Assessment of:					
h. Signs of child abuse	❑	❑	❑	❑	❑
i. Indications of family in crisis	❑	❑	❑	❑	❑
j. Impact of patient's health on family functioning	❑	❑	❑	❑	❑
k. Developmental level	❑	❑	❑	❑	❑