PhD Thesis: How Does Ontario Primary Care Perform? Effectiveness, Costs and Efficiency

by

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Abstract

In 2001, Ontario began introducing new primary care models characterized by physician remuneration mechanisms, interdisciplinary teams, access requirements, and patient enrolment. The objectives of the primary care reform were to improve the quality of and access to primary care and to make primary care more attractive as a physician specialty.

This thesis explores the performance of the new primary care models – enhanced fee-for-service (FFS), blended capitation, and interdisciplinary teams - compared to the traditional FFS model. The effectiveness, costs and efficiency are reviewed separately in three distinct studies.

The study about effectiveness aims to measure the risk of having a hospitalization for an ambulatory care sensitive condition (ACSC). The risk of having an ACSC hospitalization was lower for patients whose physician practiced in an enhanced-FFS or in a capitation model compared to patients whose saw a FFS physician. It was higher for patients who saw physicians who worked in interdisciplinary teams.

The second study examined primary care costs and total health care costs for a randomly selected 10% sample of the Ontario adult population. The costs were calculated at the individual level based on the prices of the services and the utilization. Compared to patients of FFS physicians,

patients in capitation models had higher primary care costs but lower total health care costs. Enhanced-FFS patients had the lowest primary care costs and total health care costs.

The third study employed a Stochastic Frontier Analysis (SFA) to assess the efficiency of physicians. The analyses were supported by survey data on a physician's hours worked on direct patient care, duration of the visits and other characteristics of a physician's practice and linked to administrative data on patient visits. After controlling for input and explanatory variables, efficiency scores were on average higher for physicians in blended capitation models and in interdisciplinary teams compared to physicians in FFS.

The three studies show significant differences across models for each of the outcomes examined (ACSC hospitalization; primary care costs and total health care costs; efficiency). More research is needed to understand these variations and the causal relationships in these variations, in order to better inform policy.

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Chapter 1

Introduction

1.1 Overview

The research has shown the relation between access to high-quality comprehensive primary care, on one hand, and higher life expectancy, decreased morbidity and infant mortality, and better quality of life, on the other hand (Macinko et al., 2003, Starfield et al., 2005). Maximizing access to care and the quality of primary care are international issues of high importance in many developed countries (Ferlie & Shortell, 2001). Multiple international studies suggest that the quality of and access to primary care in Canada are poor, as compared to the quality and access in other similarly wealthy countries. (Shoen et al., 2004, Shoen et al., 2005).

In 2001, Ontario, the most populous province in Canada, with a population of 13 million, started to undertake an important reform to improve its primary care system through the introduction of new primary care models.

There are five new models: Family Health Networks, Family Health Groups, Family Health Organizations, the Comprehensive Care Model, and Family Health Teams. These models are promoting formal patient enrolment with a primary care physician. The models are defined by their remuneration schemes and structural characteristics (i.e., require a minimum number of physicians, after-hours care, interdisciplinary team, etc.); they may include elements of both these defining features. The majority of physicians have now associated themselves with one of these models, although some continue to be paid on an entirely Fee-for-Service basis or on a salaried basis in Community Health Centres. The introduction of these models changed the structure and organization of primary care services during the past two decades. These changes shifted primary care in Ontario from delivery in solo practices to group and interdisciplinary

team-based practices, and from mainly fee-for-service to mixed payments. The reform also set up requirements and incentives to enhance access to care and the delivery of preventive services.

Despite the expansion of these new models, evaluation of the performance of primary care across each payment and organizational model remains limited. In addition, assessment and evaluation of primary care models have focused on processes of care. This thesis includes three empirical studies that analyze three aspects of performance: effectiveness, costs, and efficiency.

1.2 Importance of Primary Care

Primary care is defined as "the provision of integrated, accessible health care services by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained partnership with patients, and practicing in the context of family and community" (Institute of Medicine, 1994). Primary care is typically seen as the first contact with the health care system. Ideally, the care is patient-centred, provided over a long period of time, and coordinated and integrated with the services of other providers (Starfield, 1998). Primary care is distinct from primary *health* care, which addresses health problems not only through primary care services, but also through the integration of health with other sectors that engage in activities that may impact a population's health, such as water and food supply, sanitation, housing facilities, and education (World Health Organization, 1978).

Primary care is often delivered in clinics by family physicians (FP) or general practitioners (GP). However, it could also be provided by other clinicians, such as nurse practitioners (NP), in a range of settings, such as primary care clinics, community health centres, at a patient's home, or in the hospital. The definition of the Institute of Medicine (IOM, 1994) suggests continuity of care through the development of sustained partnerships between clinicians and patients, in the form of relationships where members of both groups share responsibility for the health of

patients. This continuity is particularly important for people with chronic conditions who require regular monitoring and management. During the past decades, there was a change in the demographic and health profiles of the population. The population in Canada is aging, and the proportion of people over 65 has been increasing (Public Health Agency of Canada, 2014). Simultaneously, there has been a shift from a preponderance of acute conditions to chronic conditions in the population. Chronic conditions are estimated to affect nine million Canadians (Broemeling et al., 2008). Patients with chronic conditions require more visits with physicians in order to continuously monitor and manage their conditions (Broemeling et al., 2008). For patients with high health care needs, a relationship with a regular physician was associated with lower health expenditures and, particularly, lower hospital costs (Hollander et al., 2009).

1.3 Primary Care in Ontario

Since 2001, Ontario has undertaken significant reforms in its primary care system through the introduction of new patient enrolment models (PEMs). A primary care model is defined by specific characteristics in the remuneration scheme of the physicians and requirements that define the structure of a practice (minimum number of physicians, after-hours care, additional resources for the hiring of other provider types in the practice, etc.). This section first describes the history of primary care in Ontario. Each of the five main primary care models developed in Ontario is then explained further.

Prior to the reform, there were mainly three models. The most common was the solo and group practices of physicians paid through fee-for-service (FFS); this model was complemented by Health Service Organizations (HSO) and Community Health Centres (CHC). HSO were groups of physicians paid by capitation, who were often working with other health care providers, including specialists. In CHCs, physicians, like all other members of the interdisciplinary team they worked with, were paid by salary. There were no standards or requirements regarding the

number of physicians or other providers in the CHCs. The HSO model was introduced in 1979 and attracted physicians who preferred spending more time with patients and having longer visits. HSO physicians also wanted to provide more comprehensive care to their patients as they worked in cooperation with other types of care providers, such as social workers, to address non-medical needs (Silversides, 1989). CHCs can be characterized as having salaried physicians and being governed by a board of directors that represents the interests of the community in which they are rooted (Gillet et al., 2001). The implementation of HSOs and CHCs was limited. By the end of 20 years after their introduction, only 54 CHCs and 81 HSOs were set up in the province. HSOs were concentrated in southwestern Ontario. One important issue raised by these models was the difficulty of measuring physicians' work because, physicians in these organizations did not bill the Ontario Health Insurance Plan (OHIP) like FFS physicians. The Ontario government was concerned about the growing interest in HSO conversion during the late 1980s. Government officials worried that the lack of other types of health care providers in some HSOs was a sign that some physicians may have seen HSOs as an opportunity for an income increase without an associated increase in care delivery (Brosky, 1990).

By 2011, the CHC model had expanded to 74 CHCs (and over 100 sites, including satellites), while the HSO model had declined. However, some features of the HSOs were expanded in new models. These features included the capitation-based payment of physicians and the integration of nurse practitioners in the primary care setting. Today, all HSOs have converted into another model.

Ontario physicians can currently practice as traditional FFS physicians, join a CHC, or join one of the Patient Enrolment Models (PEMs), which include the Comprehensive Care Model (CCM), Family Health Groups (FHG), Family Health Networks (FHN), Family Health Organizations (FHO), and other "harmonized" models. In addition, FHNs and FHOs can apply to form a Family Health Team (FHT), in which the physicians continue to be remunerated through the FHN or FHO payment mechanisms. The FHT receives additional funding to hire other health care professionals and pay for related administrative expenses. The term "harmonized models"

designates models where the payments were modified to align with blended capitation payment models. Harmonized models include the Rural-Northern Physician Group Agreement (RNPGA), the Group Health Centre (GHC), the Blended Salary Model (BSM), St. Joseph's Health Centre-Toronto, the Weeneebayko Health Ahtuskaywin (WHA), the Inner City Health Association (ICHA), GP Focused-HIV Groups, and the Hamilton Shelter Health Network (Fitzpatrick, 2010). These harmonized PEMs were not included in this study because of the very small number of practices in each of these models (some include only one practice).

The five main current models included in this thesis are described below.

1.3.1   Comprehensive Care Model

The Comprehensive Care Model (CCM) is quite similar to the traditional FFS model in the sense that it consists of solo practices where physicians are paid directly through FFS billing, as per the Schedule of Benefits. However, in the CCM, physicians are required to provide extended hours, and they receive incentives to enroll more patients. For each enrolled patient, physicians receive financial incentives for providing specific preventive services and also care management for defined conditions. The delivery of these services is measured using the billings from the physician's billing schedule, and payments are received only for services delivered to enrolled patients. Physicians also receive premiums for enrolling unattached patients; if physicians are new graduates, they receive new patient incentives.

1.3.2   Family Health Networks

In 2001, the Ontario government introduced the Family Health Network model (FHN), which consists of groups of at least three physicians working together. In this model, the physicians

receive a capitation payment adjusted for the age and sex of each enrolled patient. The capitation rate is meant to cover a "basket" of services; outside of this basket, services are paid for on a FFS basis. Moreover, the physicians receive 15% of the FFS rate for delivering defined services. They are required to provide on-call services and extended hours. Many of the HSOs converted into FHNs. In the FHN model, there is no minimum number of patients required, but the remuneration scheme encourages a high roster, up to 2,400, and, after that number, payment per additional patient is reduced.

1.3.3   Family Health Groups

The Family Health Group (FHGs) model was introduced in 2003. This model aims to encourage FFS physicians to work in group settings instead of in solo practices. A minimum of three physicians (not necessarily co-located) is required to form a FHG. Enrolment of patients is optional and encouraged with a financial incentive. Physicians receive FFS-based payments. They also receive incentives and premiums for specific services provided to enrolled patients. FHG physicians are required to provide on-call services and extended hours.

1.3.4   Family Health Organizations

Launched in 2007, the Family Health Organization (FHO) is now the predominant physician enrolment model in Ontario in terms of both the number of physicians -- 4,266 of the about 11,500 family physicians in Ontario (OMA 2013) -- and the number of patients enrolled -- about 4.5 million in a population of about 13 million (Fitzpatrick, 2010). FHOs consist of teams with a minimum of three physicians who provide on-call services and extended hours. Physicians are paid through a blended capitation method; the capitation rate is adjusted for the age and sex of each enrolled patient. Physicians receive 15% of the FFS rate for services included in the capitation rate and the full FFS payments for other services not in the capitation basket. They

receive premiums and bonus payments similar to FHNs. There is no minimum or maximum limit on the roster size, but the payment is reduced for each patient enrolled beyond 2,400 patients. The FHO core services include codes for minor, intermediate, and general assessments, visits to a patient's home, lab procedures (cholesterol, glucose, pregnancy, urine analysis, etc.), immunizations, psychotherapy, periodic health exams, and consultations with other physicians, to name a few services. A complete list is available from the Ministry of Health and Long Term Care [MOHLTC] (MOHLTC, 2014). The capitation does not include any services provided by specialists. There are specific lists of codes for patients who are in long-term care.

1.3.5   Family Health Teams

Since 2005, physicians have been able to apply to form a Family Health Team (FHT). The FHT model is based on care delivered through interdisciplinary teams, and the patient is also enrolled with a physician. This is an organizational model only and not a payment model because the FHT physicians are remunerated according to the plan of one of the remuneration models. Remuneration can be based on blended capitation, which is the payment model of a FHN or a FHO. Most of the FHTs are FHOs. Two other possible models are complement-based remuneration plus bonus and incentive payments (RNPGA) and a blended salary model. The blended salary is the type of remuneration encountered in community-sponsored or mixed-governance Family Health Teams where the salary level is determined by the number of patients enrolled with the physician. Most of the FHT entities result from applications by FHOs and FHNs for additional funding to hire other types of providers, such as social workers, dietitians, or nurse practitioners. The physicians are also expected to contribute to the overhead expenses of running a FHT.

The changes made by the new models can be summarized as follows: (1) the enrolment of patients with a physician, (2) new blended payment models, (3) a focus on preventive care and chronic care management, with financial incentives for specific services, (4) extended access to

health care services with the on-call and after-hours requirements, (5) a shift from solo to group-based and team-based practices. Appendix 1 provides a summative table of the models.

All these changes aim to contribute to the characteristics of high-quality primary care, namely, continuity, access, and accountability, as defined by the IOM (1994). Accountability refers to the providers' sense of responsibility to deliver the level of care corresponding to their patients' needs. Patient enrolment contributes to the continuity of the relationship between patients and their primary care providers, and builds on the evidence that a higher level of attachment to a primary care practice results in lower costs, particularly for patients with high needs (Hollander et al., 2009). Capitation payment enhances the accountability of physicians to their patients because, in this modality, payment is tied to the physicians' commitment to provide a basket of services to their patients (Institute of Medicine, 1994). Access to physicians is one of the key elements of high-quality primary care; provision of on-call and after-hours services is an element of improved access to health care services, and improved access to one's primary care physician is associated with fewer emergency admissions to hospitals (Bankart et al., 2011). Moreover, Reinhardt (1972) found that health group practices were more productive than solo practices in delivering visits to patients. The observation was also made that team work and interdisciplinary care contribute to a higher quality of services and patient satisfaction, as well as to lower hospital costs (Borrill et al., 2001).

The purpose of these new models is to improve the health of Ontarians through better primary care. Most Ontarians are now enrolled with a physician in a Patient Enrolment Model (Fitzpatrick, 2010). This enrolment suggest that there has been an important shift from remuneration of physicians based on the number of visits (under a FFS payment) to the linkage of remuneration to the number of patients enrolled with the physician (under capitation models).

1.4 Thesis Outline

This thesis uses quantitative methods, and it contains three empirical studies and a discussion of the results. All three empirical studies used a cross-sectional study design and were conducted at the Institute for Clinical Evaluative Sciences (ICES). All the analyses conducted used patient-level data to adjust for patient characteristics, including their age, sex, health status (with the Adjusted Clinical Group® weight), and socio-economic status (with the neighbourhood income quintile).

The first empirical study in Chapter 2 was based on linked patient-level administrative data. The study examined the risk that patients previously diagnosed with an ambulatory care sensitive conditions (ACSC) would be hospitalized. ACSC hospitalizations are hospitalizations for conditions considered to be manageable in a primary care setting and potentially preventable. This study built on the large literature about ACSC hospitalizations and applied the ACSC hospitalization indicator to assess the effectiveness of the primary care models. It utilized this indicator with an innovative approach that treats patients as the unit of analysis. All patients diagnosed with an ACSC in the two-year period prior to the study period were included in the cohort and assigned to the primary care model of the physician with whom they were formally enrolled. The study analyzed and compared the risk of an ACSC hospitalization for patients belonging to each of the primary care models, using patients in the FFS model as the reference group.

The study in Chapter 3 examined total health care costs and primary care costs associated with patients in each primary care model. The study used a method recently developed by Wodchis et al. (2013) to calculate health care costs at the patient level. The method is based on the price of each service and the utilization of services by an individual. The study modelled the costs as a

function of the primary care model to which a patient belongs. Primary care models were mutually exclusive. Because FHTs are originally also FHNs or FHOs, these were separated from the others to distinguish patients in FHT-funded FHNs from patients in non-FHT funded FHNs, and also patients in FHT-funded FHOs from patients in non-FHT funded FHOs. Primary care costs and total health care costs were both analyzed using generalized linear models. This study provides a comparison of the costs for patients across models. The total health care costs were inclusive of the primary care costs. The results of the study indicate the marginal incremental costs associated with a patient belonging to each model, using the FFS patients as the reference group.

The third empirical study, described in Chapter 4, examined the efficiency of primary care physicians. The efficiency was determined by two stochastic frontier analysis models for each of the two outputs: the number of visits and the number of patients seen. The inputs were the number of hours spent on direct patient care by each physician. This empirical study is different from the previous two; in this study, the physician is the unit of analysis. For this study, survey data were collected from 183 self-selected primary care physicians in Ontario, with the collaboration of the College of Family Medicine for the recruitment of physicians. Participants received a package with four questionnaires, including a questionnaire on the characteristics of the participating physicians and a questionnaire on the characteristics of their practices. Participating physicians provided their billing numbers and agreed to have their survey data linked to administrative databases. The billing numbers were used to identify patient visits, which were linked to other databases to determine the characteristics of each patient seen. The data at the patient level were aggregated at the physician level in order to adjust for the characteristics of each physician's patient population. The results of the analysis showed a range of efficiency scores. Physicians in blended-capitation and physicians in interdisciplinary team models had the highest mean efficiency scores, while FFS physicians had the lowest.

The results of the three empirical studies are discussed and analyzed in Chapter 5, which is a synthesis of the previous chapters. The chapter provides a summary of the empirical studies and

examines the contributions, the limitations, the policy implications, and the directions for future research.

This thesis provides an assessment of the performance of the various Ontario primary care models in terms of effectiveness, costs, and efficiency at one point in time. It identifies differences across the primary care models and raises questions about how primary care is organized and delivered.

Chapter 2. How Does the Risk of a Hospitalization for an Ambulatory Care Sensitive Condition Vary across Primary Care Models?

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Abstract

Objective: Analyze the relationship between the risk of a hospitalization for an ambulatory care sensitive condition (ACSC), on one hand, and the primary care payment and the organizational model used by the patient (fee-for-service, enhanced fee-for-service, blended capitation, blended capitation with interdisciplinary teams), on the other hand.

Data sources/study setting: The study used linked patient-level health administrative databases and census data housed at the Institute for Clinical Evaluative Sciences in Ontario. Since the province provides universal health care, the data capture all patients in Ontario, Canada's most populous province, with about 13 million inhabitants.

Study Design: All Ontario patients diagnosed with an ACSC prior to April 1, 2012, who had at least one visit with a physician between April 1, 2012, and March 31. 2013, were included in the study (n=1,710,310). Each patient was assigned to the primary care model of his/her physician. The different models were categorized as Fee-for-Service (FFS), enhanced-FFS, blended capitation, and interdisciplinary team. A logistic regression was used to model the risk of having an ACSC hospitalization during the one year observation period. Adjustments were made for patient characteristics (age, sex, health status, and socio-economic status) and for the geographic

location of the practice.

Data collection: Not applicable

Principal findings: Using patients belonging to fee-for-service models as the reference group, the finding was that the risk of an ACSC hospitalization was higher for patients belonging to the blended-capitation model using interdisciplinary teams (Adjusted Odds Ratio [AOR] = 1.06, 95% confidence interval [CI] = 1.00-1.12) and lower for enhanced-FFS (AOR = 0.78, CI= 0.74-0.82) and blended capitation patients (AOR = 0.91, CI= 0.86-0.96). The odds of an ACSC hospitalization were much higher for patients with an ACSC other than hypertension and increased with patients' morbidity. The risk was lower for patients of higher socio-economic status (AOR=0.63, CI=0.60-0.67 for a patient in the highest neighbourhood income quintile).

Conclusion: Enhanced-FFS and blended capitation models were associated with a lower risk for ACSC hospitalizations, as compared with the FFS model. Interdisciplinary teams appear to be less effective than FFS physicians, given the teams' higher rate of ACSC hospitalizations.

Key words: primary care; ambulatory care sensitive conditions; avoidable hospitalizations; effectiveness; physician remuneration

2.1 Context

Primary care in Ontario is delivered by physicians remunerated through various mechanisms. The most common are: Fee-for-Service (FFS), enhanced-FFS, and blended capitation. In the third mechanism, most of the physicians' remuneration is based on a fixed rate per patient enrolled, with the rate adjusted for each patient's age and sex. Physicians working in blended capitation models can apply for additional funding to hire other health providers and form a Family Health Team (FHT). The mix of health providers and the programs offered in FHTs are geared to meet the needs of the community served and to assist the physician's work with the support of an interdisciplinary team environment.

Enhanced-FFS physicians receive most of their remuneration through fee-for-service, with additional payments for the registration of new patients, comprehensive care management, after-hours care, diabetes and heart failure management, and preventive care (vaccinations, cancer screening, and smoking cessation).

In contrast to the FFS model, enhanced-FFS and blended capitation are patient enrolment models (PEMs) that encourage physicians (with financial incentives) to formally enroll patients by having them sign a form that states their agreement to see that physician for their primary care needs. There is no obligation for the patient to enroll, and physicians do not have to enroll all of their patients. Physicians working in PEMs may see patients not enrolled to them; in such cases, they are paid on a FFS basis. Moreover, physicians do not receive the incentive payments to provide services on the list of chronic disease management and disease prevention services for the patients not enrolled with them. These patients are also not counted in the bonus and premium payments for achieving performance targets. Physicians in blended capitation models are encouraged to be available to their patients through the provision of an access bonus. The

amount of the bonus is reduced when a physician's patients seek care from another physician. A physician providing services to a patient enrolled with another physician is paid on a FFS basis for that patient.

2.1.1   Hospitalizations for Ambulatory Care Sensitive Conditions

The effectiveness of primary care has been measured with a number of performance indicators, which are either process-oriented indicators or outcome-oriented indicators.

In this study, effectiveness is considered from a health outcome perspective in terms of potentially avoidable hospitalizations, in cases where the main reason for the hospitalization is an ambulatory care sensitive condition (ACSC). The ACSCs considered in the study are those defined by the Canadian Institute for Health Information (CIHI, 2012) and include chronic conditions. Specifically, ACSC hospital admissions for the study are admissions for: angina, asthma, congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), diabetes, grand mal status and other epileptic convulsions,[1] and hypertension, among people under 75 years of age (as per the CIHI definition) who were previously diagnosed with these conditions. ACSC hospitalizations are considered potentially preventable because they are related to conditions that should not require hospitalizations, if they are appropriately treated and managed in a primary care setting (Billing et al., 1993; Brown et al., 2001; Caminal et al., 2004; Bindman et al., 2008; Chen et al., 2009; Laditka et al., 2005).

The rate of ACSC hospitalizations has been used as an indicator of both access to and the effectiveness of primary care. The rate is also used as a measure of the effectiveness of new policies aimed at strengthening the primary care sector (Burgdurf & Sundmacher, 2014; Brown et al., 2001; Ibanez-Beroiz et al., 2014; Nedel et al., 2005, 2008; Rubinstein et al., 2014;

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[1] Hereafter referred to as epilepsy for the sake of simplicity.

Sundmacher & Kopetsch, 2014). A higher rate of ACSC hospitalizations was observed in regions with a lower supply of primary care physicians (Laditka et al., 2005) and amongst people facing financial barriers, such as people with no health care insurance who have to pay out-of-pocket for primary care visits (Billings et al., 1993). There are also studies that examined the effect of socio-economic status in countries with universal health insurance, where people do not have financial barriers in terms of having to pay out-of-pocket at the point of service. These studies also found that visits to the emergency department and admissions for ACSCs were higher for low-income people (Huntley et al., 2014; Roos et al., 2005), despite their higher utilization of primary care services (Roos et al., 2005). These results suggest that lower income people may need not only more care but also different types of care. In cross-country comparisons, Rosano et al. (2013) found that the ACSC hospitalization rates were lower in the health systems with a stronger primary care sector (as opposed to a hospital-centric health care system) and in systems where the primary care physician had a more important role, including the role of gatekeeper in relation to specialists' services.

The ACSC hospitalization rate is considered to be a valid indicator of the quality of primary care as long as adequate adjustment is made for variation in patient characteristics (Rosano et al., 2012; Eggli et al., 2014).

2.1.2   ACSC Hospitalization and Ontario Primary Care

There are different ways to calculate the ACSC hospitalization rates, and the information that the rates provide differs, depending on how the numerator and denominator are measured. In Ontario, the ACSC hospitalization rates are reported as a ratio of the total number of hospitalizations for ACSC per 100,000 people (Health Quality Ontario, 2013). Because the number in the denominator is not limited to the people diagnosed with ACSCs, but instead captures the whole population, the rates are affected by the prevalence of each of the conditions on the list of ACSCs in the population. The prevalence of each condition on the list of ACSCs

may also vary over time; for example, the prevalence may vary if there are changes in the criteria established for diagnosing a condition, or if changes in the lifestyle habits of the population impact the risk factors for some conditions but not for others, or if members of the public and physicians are more aware of some conditions and are more knowledgeable about their treatment and management. ACSC hospitalization rates are also often reported as a unique rate that combines all the ACSCs. The problem with such a method is that it may be affected by which conditions amongst the ACSCs affect the population most. Some of the conditions on the list of ACSCs may lead more than others to a hospitalization. A pan-Canada study (excluding Quebec) also found that ACSC hospitalizations were disproportionately due to COPD, which accounted for 29% of all ACSC hospitalizations (Sanchez et al., 2008), but the study did not tie the hospitalizations to the prevalence of the conditions.

Measuring the hospitalization rate at the level of the population constitutes a limitation in terms of the indicator's validity as a measure of the effectiveness of primary care, given all the factors that may affect the ACSC hospitalization rate. A more specific approach is the use of only the population that has an ACSC as the denominator and the number of ACSC-related hospitalizations within that population as the numerator.

2.1.3   Factors Affecting ACSC Hospitalizations

Although many determinants of ACSC hospitalizations have been studied, most of them are related to patient characteristics, for example, socio-demographics, socio-economic status, and health status, including multi-morbidity (Rosano et al., 2012; Saver et al., 2013) and also related to health care system characteristics, as defined in inter-country or inter-region comparisons.

Recent systematic reviews examined the literature on ACSC hospitalizations, and the findings support the validity of a hospitalization rate as an indicator of the quality of primary care

(Rosano et al., 2013). Moreover, van Loenen et al. (2014) identified two aspects of primary care that are associated with lower hospitalization rates for chronic ACSCs: an adequate supply of primary care physicians and long-term relationships between patients and physicians. The importance of the supply of physicians was also identified in a systematic review that excluded studies conducted in a system that relies on user fees (Gibson et al., 2013). The review by Gibson et al. was focused on populations that, in theory, did not have financial barriers to accessing primary care.

The literature on ACSC hospitalizations is limited in relation to specific characteristics at the practice level that could affect the quality of primary care delivery. The present study aims to fill this gap in examining the relationship between ACSC hospitalizations and Ontario primary care models, in terms of the payment schemes for physicians and in terms of structures where physicians work in groups and in interdisciplinary teams.

The primary care models, including the structure and payment characteristics could affect how physicians deliver care, and physicians' behaviour in care delivery could affect patient outcomes. For example, a physician who has an incentive to have more visits with a patient may see the patient more often. Physicians who receive performance bonuses for achieving better outcomes might be providing better care to patients for whom the physicians can receive the bonus payments. Specific requirements for physicians working in groups, such as keeping the clinic open after regular hours (i.e., evenings and weekends), enhances access to the physicians and may prevent patients from going to the hospital.

This study categorizes patients and physicians according to payment models (Fee-for-Service, enhanced-FFS, and blended capitation) and according to whether or not services are offered by an interdisciplinary team.

2.1.4   Payment System

In the enhanced-FFS model, physicians do not have any incentives to provide more services, as compared to physicians in the pure fee-for-service model. In both models, remuneration is based on the volume of services provided. The FFS payment method has generally been associated with an overprovision of care (Brosig-Koch et al., 2013; Gosden et al., 2000). The enhanced-FFS physicians receive additional payments for their *enrolled* patients when they provide specific services, which are related mostly to prevention and disease management (for example, diabetes and heart failure management, cancer screening, smoking cessation). Some evidence suggests that the enhanced-FFS model supports the continuity of care to a greater degree, as compared with the pure FFS model. This increase in continuity could be linked to the payments for preventive care (Kralj & Kantarevic, 2012). Therefore, patients of enhanced-FFS physicians may receive better care and face a lower risk of ACSC hospitalization, as compared to FFS patients.

Physicians in the blended capitation models have an incentive to have a higher number of patients on their roster (up to 2,400, and, beyond that number, the payments are reduced for the additional enrolled patients), but to provide minimum care, since the capitation fee is independent of the intensity of the care or severity of the patient's condition, except for adjustments for age and sex. However, additional payments are offered to deliver a list of specific services, such as chronic disease management. The capitation rates are meant to cover a defined basket of services. Given that physicians are remunerated through FFS for any services not included in the basket, they have an incentive to increase the intensity of the care with services that are not included in the capitation rate in order to increase their income. Because the capitation fee is also independent of the utilization of other resources, such as specialists' care, there is an incentive for physicians in the blended capitation model to refer their patients to other health providers in order to lower their own effort. This behavior may be particularly present in the cases of patients who require a level of care that is higher that the level of care that the physician is compensated for in the capitation payment. Because capitation rates are only age and sex adjusted, patients enrolled are likely to be healthier and to require minimum care

(Glazier et al., 2012; Rudoler et al., 2014). It is also possible that the payment incentives in the blended capitation model may lead to the provision of less patient care than is necessary and to a greater likelihood of an ACSC hospitalization for patients in blended capitation models than for those in FFS models, all else being equal. Capitation payments create an incentive for physicians to lower the intensity of the care provided to each patient so that they can maximize the number of patients enrolled with them. An underprovision of services may result in lower quality in the management and control of the chronic conditions and, consequently, a higher risk of an ACSC hospitalization for patients.

2.1.1   Interdisciplinary Team Organization

Physicians working in a blended-capitation model can form interdisciplinary teams called Family Health Teams (FHTs). The Ontario health reform has encouraged physicians to join interdisciplinary environments that offer multiple theoretical advantages, such as increased timely access through after-hours care and on-call services (Haggerty et al., 2008) and a higher quality of care (Lin et al., 2004; Russell et al., 2009; Sommers et al., 2000). FHTs are considered to adhere to the seven principles of the patient-centred medical home model developed in the United States, i.e., personal physician, physician-directed medical practice, whole-person orientation, coordination and integration of care, quality and safety, enhanced access, and payment reflective of the value for patients (Rosser, 2011). In the United States, the patient-centred medical home model has been associated with lower ACSC hospitalization rates (Yoon et al., 2013). Given the empirical evidence about better quality of care in an interdisciplinary team setting, one may expect to find lower odds of ACSC hospitalizations for patients in FHTs, as compared to patients in FFS.

The implementation of the primary care reform in Ontario was gradual and is still fairly new. A number of studies compared the Ontario models as they were being introduced. Studies focused on the characteristics of the patients and the use of emergency departments across models

(Glazier et al., 2012) or on the characteristics and processes of care for specific conditions. Most studies compare new models to the traditional FFS model. The findings include: superior chronic disease management (Russell et al., 2009) and community orientation in Community Health Centres (Muldoon et al., 2010), higher gender equity in chronic disease care (Dahrouge et al., 2010), higher screening and blood pressure control for hypertension (Tu et al., 2009) in capitation models, and better asthma care in an enhanced-FFS model (To et al., 2015).

The literature is sparser in terms of measuring patient outcomes in relation to the quality of primary care. ACSC hospitalizations have not yet been examined in relation to the Ontario primary care models. The present study aims to fill this gap. The objective is to assess the effectiveness of the Ontario primary care models by analyzing how the risk of an ACSC hospitalization varies across different primary care models, using FFS patients as the reference group.

2.2   Methods

The study period is April 1, 2012, to March 31, 2013. The study population consists of all Ontarians under the age of 75 who were diagnosed with at least one ACSC. Since Ontario has a universal health insurance plan (OHIP), there was no selection based on the ability to pay or on insurance status; all Ontarians meeting the criteria were included. The ACSCs are the seven chronic conditions listed in the Canadian indicator for ambulatory care sensitive conditions (with the corresponding ICD 10 diagnosis codes available in the Appendix), i.e., asthma, diabetes, CHF, COPD, hypertension, epilepsy, and angina. The purpose of the age limit of 75 is to maintain alignment with the current CIHI definition of the ACSC indicator, which is based the lower preventability of these hospitalizations amongst older people. An ACSC diagnosis is defined by at least two physician billings or one acute hospital admission record with one of the seven conditions mentioned above between April 1, 2010 and March 31, 2012, i.e. in the 24-

month period prior to the year under study. This is the method used in Ontario to determine the prevalence and the incidence of chronic diseases (Hux & Tang, 2003). People who died during the period of the study interval were excluded.

2.2.1   Study Design

This is a retrospective study that analyzes administrative data from the past utilization of health care services, using data available at the Institute for Clinical Evaluative Sciences (ICES). The ICES uses an ICES Key Number (IKN) to uniquely identify each person and to allow for linkage of patient-level data across databases.

Using the IKNs, patients' enrolment data at the beginning of the study period were used to link patients to their primary care physician and to identify the corresponding model of the physician (FFS, enhanced-FFS, blended capitation, and FHT). Patients who were not formally enrolled with a physician were considered FFS patients for the purpose of the study. Models were mutually exclusive, so each patient could only belong to one model.

2.2.2   Data Sources and Variables

The outcome variable is a binary variable that takes the value of one if the individual had one or more hospitalizations for a pre-existing ACSC between April 1, 2012, and March 31, 2013. The explanatory variables include the patient's primary care model (FFS, enhanced-FFS, blended capitation, or FHT), the patient's age –as a continuous variable, sex, health status in relation to each ACSC, having multiple ACSCs and the Johns Hopkins Adjusted Clinical Group System (ACG®) weight, the neighbourhood income quintile as a proxy for socio-economic status, and

the Rurality Index of Ontario score to adjust for the geographic location of the primary care practice.

The ACG® weight is a case-mix continuous variable for which the algorithm was developed by The Johns Hopkins University (www.acg.jhsph.org). The variable takes into consideration the effect of "combinations of types of disorders" (Starfield et al., 1991). The ACG® system was validated in multiple settings, including Ontario, where it was used for a number of studies on primary care (Glazier et al., 2009; Sibley et al., 2011).The ACG® weight adjustment is also considered to be a more valid case-mix measure than any other that is currently available for primary care (Carlsson et al., 2002; Reid et al., 2002). The weight is based on all the diagnoses that a patient had in a 24 month period, which would include all the ACSCs.

The RIO score is a continuous variable that takes a value between 0 and 100; lower values indicate an urban location. The RIO is a measure developed by the Ontario Medical Association for Ontario communities (Kralj, 2009). The RIO is based on the following 10 variables: travel time to the nearest basic referral centre, travel time to the nearest advanced referral centre, community population, the number of active general practitioners (GPs), the population-to-GP ratio, the presence of a hospital, the availability of ambulance services, social indicators, weather conditions, and selected services.

Data on hospitalizations were taken from the CIHI - Hospital Discharge Abstract Database (DAD). This database contains "demographic, administrative and clinical data for hospital discharges" (Ministry of Health and Long Term Care [MOHLTC], 2006). The IKNs in the DAD are used to link to patients' data contained in other databases, and to retrieve the main diagnostic code (the main reason for the hospitalization), and the date of the admission to the hospital.

Each patient's primary care model was derived from data contained in the Client Agency Program Enrolment (CAPE) database. The CAPE database contains the enrolment data of each patient who is enrolled with a primary care physician and also indicates the primary care model with which each physician is affiliated (MOHLTC, 2006).

Patients' socio-demographic data were collected from the Ontario Registered Persons Database (RPDB). Patients' neighbourhood income quintiles were derived from postal codes that are available in Census Data.

Each patient's ACG® weight was calculated, using a patient's health services utilization data from the 24-month period prior to the study period, with diagnostic data from the DAD and from the billings in the Ontario Health Insurance Plan (OHIP) database. OHIP is a database of the billings from physicians and contains individual-level information on the services provided.

2.2.3   Statistical Analysis

This study examines the risk for a patient i to have an ACSC hospitalization, conditional on that individual having an ACSC and clustered at the physician j. For this study, a logistic regression is used that is defined as:

$\log(\text{ACSCH} \mid \text{having an ACSC})_{ij} = \beta_0 + \beta_1 enhanced\text{-}FFS_{ij} + \beta_2 blended\_cap_{ij} + \beta_3 FHT_{ij} + \beta_4 RIO_{ij} + \beta_5 age_{ij} + \beta_6 male_{ij} + \beta_7 ACG_{ij} + \beta_8 ACSC_{ij} + \beta_9 Two\_or\_more ACSCs_{ij} + \beta_{10} incomequintile_{ij} + \varepsilon_{ij}$

Binary variables were included for each of the seven ACSCs. Within ACSCs, the hypertension group of patients was selected as the reference group for this study. The income quintile was

measured with four binary variables for income quintiles two, three, four, and five (using income quintile one, i.e., the lowest income group, as the reference).

The regression was run using the *logistic* command in STATA® version 13, with robust standard errors and clustering with the physician number. The *lroc* post-estimation command was used to examine the area under the curve.

The study received approval from the Research Ethics Board of the University of Toronto.

2.3 Results

This section provides a comparative description of the characteristics of the patients in each primary care model, the number of patients diagnosed with each of the conditions across models and their the hospitalizations, and the results from the logistic regression, which show the adjusted odds ratio of an ACSC hospitalization for patients in each primary care model, using FFS patients as the reference.

The study population contained 1,710,310 patients with an average age of just over 52. About 12% of the patients had two or more ACSCs. The patients appeared relatively similar across models, except for the reference group (FFS), in which patients were younger (mean age 46) and less likely to be male (46%). There were 296,961 FFS patients, including patients who see a physician in an enrolment model, but are not enrolled with the physician, and patients who see FFS physicians (such as physicians working in walk-in clinics). A notable difference is the higher proportion of patients with asthma amongst FFS patients than the proportion for the whole study population (26% versus 16%). The proportion of patients from neighbourhoods of lower

income quintiles is higher amongst FFS patients than amongst patients in any other model, with 23.2% and 21.2% of FFS patients in income quintiles 1 (lowest income quintile) and 2, respectively. Only 16.1% of these patients were in the highest income quintile. Patients in blended capitation and FHT models were generally healthier and wealthier (Table 2.1).

[Table 2.1. Descriptive Statistics for all Patients with ACSCs and by Primary Care Model]

In Table 2.2, the rates of ACSC hospitalization for patients with each different condition and for each model are reported. The differences in the percentage of hospitalizations suggest that some conditions are more likely than others to lead to an ACSC hospitalization, i.e., CHF (5.93% to 6.84%) and COPD (5.30% to 7.64%). Rates of hospitalizations are the lowest for patients with hypertension (varying between 0.47% and 0.59%, depending on the model to which the patient belongs).

[Table 2.2. ACSC hospitalizations across models and for each condition]

The results from the logistic regressions are reported in Table 2.3. In the table, the adjusted odds ratios measure for each variable the risk that a patient will have an ACSC hospitalization. The primary care model binary variables are the independent variables of interest for our analysis.

The results show that the adjusted odds ratio (AOR) of an ACSC hospitalization for FHT patients is 1.06 (95% Confidence Interval [CI] = 1.00-1.12) that of FFS patients. For patients enrolled with a physician in an enhanced-FFS practice, the AOR is 0.78 (CI=0.74-0.82), whereas the AOR is 0.91 (CI=0.86-0.96) for patients with FHT blended capitation physicians, using FFS patients as the reference group.

Additional factors associated with higher odds of an ACSC hospitalization are a higher ACG®
weight (AOR=1.41, CI=1.39-1.42), a higher level of rurality (AOR=1.01, CI=1.01-1.01), and a
diagnosis with any ACSC other than hypertension, which was the reference group. The odds
decrease for patients living in neighbourhoods in higher income quintiles (AOR=0.63, CI=0.60-
0.67 for patients in neighbourhoods in income quintile 5, i.e., the highest, as compared to income
quintile 1, i.e., the lowest), and for older patients (AOR=0.997, CI=0.996-0.998 for each
additional year). However, patients' age is also one of the components of the ACG®, and so it is
already indirectly adjusted for in the algorithm of the ACG® weight.

**[Table 2.3 Odds of an ACSC Hospitalization for ACSC Patients, Using FFS Patients as the
Reference Group]**

Interactions between every possible combination of two ACSCs were explored. Although many
coefficients on these interaction terms were significant, they did not improve the predictive
power of the model. The results were similar in terms of the coefficients on the primary care
model variables. The interaction terms suggested that patients with a combination of
hypertension with another condition were less at risk of a hospitalization, as compared with
patients who had only that other condition. The interaction terms also suggested that patients
who had a combination of two other conditions (excluding hypertension) were generally at
higher risk of an ACSC hospitalization.

Sensitivity analyses were conducted through a different categorization of the not-enrolled
patients, and the categorization did affect the results. For example, patients who saw physicians
in an enrolment model, but were not enrolled with the physician, were at a higher risk of a
hospitalization when they were treated as a distinct group, and they changed the coefficients on

the primary care model variables when they were assigned to the primary care model of the physician they had seen.

2.4   Discussion

2.4.1   Primary Care Model and Risk of ACSC Hospitalization

To our knowledge, this is the first study to look at associations between ACSC hospitalizations and primary care models in Ontario. The results show that there are significant differences in the risk of an ACSC hospitalization, after adjustments are made for other factors, such as patient characteristics and geographic location.

More specifically, the results of the logistic regression show that patients who belong to blended capitation models had a lower risk of an ACSC hospitalization, as compared to FFS patients (AOR=0.91, CI=0.86-0.96). It is an interesting finding that the enhanced-FFS primary care model, in which physicians receive most of their remuneration through FFS, is the most effective model in the sense that it shows the lowest odds of an ACSC hospitalization (AOR=0.78, CI=0.74-0.82). The result is aligned with the most recent study, which focused on asthma care and found better asthma care and fewer emergency department visits for asthma amongst patients of enhanced-FFS physicians, as compared to patients of FFS physicians (To et al., 2015). The finding could mean that the specific differences between the FFS and the enhanced-FFS models are particularly important and beneficial to patient outcomes. Enhanced-FFS physicians receive additional payments for the enrolment of patients and for providing comprehensive care to those patients. Hence, enhanced-FFS physicians have incentives to maximize the intensity of services and to manage chronic conditions for a patient population. Taken together, these elements may potentially support the development of a better patient-physician relationship than the relationship in the FFS model. This kind of relationship could explain the lower risk of an ACSC hospitalization amongst patients of enhanced-FFS physicians.

The fact that the patient population of enhanced-FFS physicians has, on average, a lower health status may also lead to a higher intensity of care. This intensity of care may benefit the management of an ACSC and explain why the risk of an ACSC hospitalization is lower amongst enhanced-FFS patients, as compared to FFS patients. Alternatively, it is possible that the incentives in place for enhanced-FFS physicians lead to over-diagnosis of patients; i.e., the enhanced-FFS patients may be actually healthier than they appear in the data, and their ACSCs may be less severe and more manageable than the ACSCs of patients in other models.

Patients in the FHTs (where physicians are also remunerated through blended capitation) had a higher risk of an ACSC hospitalization, as compared to FFS patients (AOR=1.06, CI=1.00-1.12). These results appear to contradict the results of other studies in Ontario, which suggest that capitation models provide better access to care (Muggah et al., 2014). In addition, in studies in Alberta, patients with diabetes enrolled with an interdisciplinary primary care team were found to receive better care and have better outcomes (Manns et al., 2011). In the US, a higher rate of medical home adoption was associated with a decrease in the ACSC hospitalizations and costs (Yoon et al., 2013), and, as noted previously, FHTs are considered the Ontario version of US medical homes (Rosser et al., 2010; Rosser et al., 2011). Patients with better access to primary care and better care are expected to have less risk of complications and/or hospitalizations. The higher risk of an ACSC hospitalization for FHT patients raises questions about the level of accessibility and the quality of care in the Ontario FHT practices, as compared to the performance of their FFS-based counterparts. However, it should be noted that data about some characteristics of the FHTs such as the resources employed and the length of time they have been in operation, were not available. Hence, future analysis and results might indicate that FHTs practices were in the process of establishing themselves when this study took place.

2.4.2   Factors Associated with Higher Risk of an ACSC Hospitalization

The study adjusted for a number of characteristics related to the physician's practice setting and a number of characteristics related to the patients themselves. Most of these characteristics were found to be significantly associated with the risk of an ACSC hospitalization. The results reported in Table 2.3, in terms of higher risk of an ACSC hospitalization for patients in more rural areas and for patients in neighbourhoods of lower income quintiles, are consistent with a previous Canadian study that looked at the risk of hospitalization for hypertension in four provinces amongst patients diagnosed with hypertension. The study found that the rates of hospitalization for hypertension were lower amongst patients living in urban settings and lower amongst the patients in the higher income quintiles (Walker et al., 2013).

The study by Walker et al. (2013) also found an increased risk of a hospitalization for hypertension in the presence of comorbidities. The results in Table 2.3 show that the risk of an ACSC hospitalization was actually lower for patients with two or more ACSCs (AOR=0.88, CI=0.83-0.93). A closer examination of the characteristics of patients indicated that the majority of the patients with two or more ACSCs had hypertension as one of the conditions. Patients with hypertension constituted the reference group with whom patients with any of the other ACSCs were compared. Hypertension was the most common condition in the study population. It is also the condition that has the lowest risk of a hospitalization; the AOR for each of the other ACSCs is higher than 1. Hence, the AOR of having two or more ACSCs reflects the interaction of hypertension with another ACSC (for most patients), and the AOR shows that having two ACSCs has a protective effect, as compared to having only one ACSC. This effect could result from the lower risk of the other condition, i.e., hypertension. People who have multiple conditions may benefit from using more services and may have better monitoring and management of their conditions. The results reported in Table 2.2 show that the risk of having an ACSC hospitalization increases amongst patients living in neighbourhoods in lower income quintiles. The income gradient was also found in Manitoba (Roos et al., 2005), in the United States (Basu et al., 2014; Finegan et al., 2010), in Australia (Ansari et al., 2013) and in Italy (Agabiti et al., 2009). Lower hospitalization rates have also been observed in wealthier regions, which were compared to regions with lower incomes, in Germany, Italy (Rosano et al., 2013) and also Sweden (Lofqvist et al., 2013). The present study suggests that the differences that have

been observed at the regional level can also be observed at the patient level. Most of these countries have universal health care systems where there are no financial barriers to patients' access to primary care. The higher risk of an ACSC hospitalization for people of lower socio-economic status reflects the reality that there are inequities in the ways people can benefit from the care and the ways they are able to manage their chronic conditions.

A few researchers have stressed the importance of considering health status and the types of patients' ACSCs when ACSC hospitalizations are examined (Eggli et al., 2014; Finegan et al., 2010; Librero et al., 2014; Saver et al., 2013). The results of the present study support this point, given that the ACG® weight and each ACSC condition significantly affected the odds of an ACSC hospitalization. Having COPD, as compared to having hypertension, represented a particularly important risk factor (AOR= 8.40, CI=7.99-8.84); this figure aligned with higher rates of hospitalization for patients with COPD that were found in Spain (Ibanez-Beroiz et al., 2014). In Ontario, some of the chronic conditions on the list of ACSCs, namely, diabetes and hypertension, receive particular attention through financial incentives associated with their management and treatment. Given the higher risk of hospitalization associated with COPD, it could be helpful to offer incentives to physicians to provide higher-quality care for COPD.

The descriptive data on the ACSC population suggests some differences amongst patients across primary care models, particularly amongst the patients in the reference group. FFS patients were younger and from lower income quintiles, while patients in blended capitation models were wealthier; these findings are consistent with what has been found in the general Ontario population (Glazier et al., 2012). Blended capitation patients appear to be generally healthier than those in other primary care models, with a lower average ACG® weight of 0.761, as compared with the overall patient average of 0.788. Given that capitation payments are adjusted only for age and sex and not for additional measures of health status, physicians in blended capitation models have an incentive to serve generally healthier patients (Hutchison & Glazier, 2013). Hence, the observed results are consistent with what could be expected, given the

incentives in place in Ontario and the current literature on the characteristics of patients served in the various primary care models in Ontario.

The finding that the odds of an ACSC hospitalization increase with rurality is also consistent with figures from other countries. Indeed, ACSC hospitalization rates were reported to be higher in rural areas in the US (Basu et al., 2014) and in Germany (Burgdurf & Sundmacher, 2014); the latter study was limited to four conditions, but they are conditions that are also in the CIHI definition (CHF, angina, hypertension, and diabetes). The increased risk associated with rurality could be related to the longer travel distances to hospitals. Hospital staff might admit patients at a lower level of severity when they consider that the patients travelled a long distance to the hospital and that the patients could not necessarily return easily if their situations worsened. The increased risk of hospitalization associated with rurality could also reflect limited access to primary care in some areas where recruitment and retention of physicians are challenges, and where patients do not visit their physicians as often as they should because of the distance to a doctor's office. Physicians in rural areas might also need to take a larger caseload, and thus make themselves less available to their patients.

The distribution of the ACSCs varies across primary care models. This variation may be related to the ease of managing some of the chronic conditions, as compared to others. The variation may also be related to the incentives in place. For example, physicians in blended capitation and FHT models have specific financial incentives for the management of diabetes and of CHF. These two conditions are also more prevalent in the blended capitation and FHT models, as compared to the FFS and enhanced-FFS models.

The prevalence of asthma is much higher amongst FFS patients (almost twice that of the prevalence in other models) without a discernible specific reason that explains this difference.

Another factor that may explain differences in the distribution of the conditions may be the structures and resources of the health system in place. For example, Ontario made large investments and provided important funding to support primary care physicians in hiring providers such as dietitians or nutritionists and/or in utilizing diabetes education teams. The only primary care model not benefiting from this governmental support was the FFS model, and it is the model with patients that have the lowest prevalence of diabetes.

It is interesting to note that the types of patients' ACSCs vary across primary care models; it is possible that, if physicians self-select themselves into a primary care model, and there is evidence suggesting that they do (Rudoler et al., 2014), their choices would be based on their patient populations and on the proposed incentives of the different models. For example, in Ontario, the finding was that physicians in blended capitation models were more responsive to a diabetes management program, as compared to physicians in FFS models (Kantarevic & Kralj, 2012) and that patients in blended capitation models were more likely than those in enhanced-FFS models to receive the recommended tests for diabetes monitoring (Kiran et al., 2014). This finding suggests not only that the quality of diabetes care may be better in blended capitation models, but also that primary care physicians may specialize in the care of specific chronic conditions that are prevalent in their patients' population.

2.4.3   Strengths of the study

The study took advantage of the comprehensiveness of the data available about the Ontario population. All Ontario patients with ACSCs are included in the study; no data should be missing, in contrast to other studies (Ibanez-Beroiz et al., 2014).

The study used the list of ACSCs developed specifically for the Canadian context, and the use of the Canadian definition in this study strengthens its internal validity. The list can be considered

restrictive, as compared to the more extensive lists used in other countries, such as the list in the UK (Purdy et al., 2009). One of the reasons why the Canadian list is more restrictive is that the list is focused on chronic conditions. The ICD codes of the chronic conditions included in the Canadian indicator are quite aligned with the list suggested by Caminal et al. (2004) in the development of a valid list of ACSCs (see Appendix). The benefit of a shorter Canadian list is its increased sensitivity to the hospitalizations that are truly preventable; this sensitivity is enhanced in this study by including only patients who were already diagnosed with the ACSCs, and excluding hospitalizations of patients who have not yet been diagnosed.

2.4.4   Limitations

It is important to remember that ACSC hospitalizations are considered potentially preventable, a consideration that means that a proportion of them may not be avoidable (Freund & Campbell, 2013). However, it is not possible to know from the study data which ones may be avoided and which ones may not and, hence, it is not possible to know if these are equally distributed across primary care models. The health status variables, particularly the dummy variables for each of the ACSCs, are important predictors of hospitalization, since conditions are not equal in terms of the risk of hospitalization. However, beyond the conditions themselves and the fact that some may be easier to manage than others, the severity of the conditions and the capacity of the patients to manage their conditions may affect the risk of an ACSC hospitalization. Little data is available to adjust for these factors.

The study does not account for patients' health behaviours, and yet unhealthy behaviours are associated with higher risks of an ACSC hospitalization (Tran et al., 2014). However, behaviours are also correlated with income and health status, which were controlled for in the present study. Evidence suggests that people with lower incomes are more likely to engage in unhealthy behaviours, including smoking, excessive alcohol use, poor diet choices, and inactivity (Buck & Frosini, 2012; Costa-i-Font et al., 2012; Laaksonen et al., 2003; Pomerleau et al., 1997); they

also experience higher rates of mortality (Stringhini et al., 2010). People with unhealthy behaviours also show a lower level of use of preventive services (Hofer & Katz, 1996). Adjusting for case-mix and conditions increases the validity of the study. As mentioned earlier, it is considered important to adjust for such patient characteristics in order to consider the effect that these conditions and the case-mix may have on the risk for a patient's hospitalization.

Although the ACG® weights have been validated to adjust for case-mix at the population level, they have not been validated at the patient level. This lack may represent a limitation to the patient health status adjustment in the regression model; yet no better measure could be found in the literature. The inclusion of age, sex, and the presence of each of the ACSCs to adjust for individual health status strengthens the analysis. With the exception of sex, these variables were all significant in predicting the risk of an ACSC hospitalization. In addition, the duration of patients' conditions was not included.

The study is focused on primary care models and not on the characteristics of the physicians working in each of these models. Recent evidence suggests that physicians may be self-selecting into these models (Rudoler et al., 2014), a choice that could be based on their practice styles, preferences, and client base. The self-selection of physicians means that some of the effects observed in the adjusted odds ratios of the primary care model could potentially be partly related to physicians' characteristics. However, there is also evidence suggesting that physicians adapt their practice styles to their working environments (de Jong et al., 2006; Wolinsky, 1982). Hence, one should be cautious in interpreting the results; there is a possibility that the associations found with the risk of ACSC hospitalizations are partly related to the characteristics of the primary care physicians, which are not accounted for in this study, and the extent of such a relationship is unknown. In addition, partly because of limited data availability, the characteristics of physicians (e.g., age, sex, number of years in practice) were not considered in this study, and neither were the characteristics of their practices, such as the size in terms of the number of physicians, administrative support, or other health providers who work in the practice.

Finally, the cross-sectional approach represents a limitation to the interpretation of the results, in the sense that it provides information about the correlations between, rather than about causal relationships between, primary care models and ACSC hospitalizations.

2.5   Conclusion

The fact that patients in the blended capitation models with interdisciplinary teams were at an increased risk of an ACSC hospitalization raises questions about the quality of the care provided in this primary care model and about physicians' accessibility to their patients. The risk level may also be related to the fact that many of the FHTs were newly implemented in 2007, and, because of the time required for physicians to put together an application and receive the funding, their organizations would not yet have been fully operational in 2012. Given that the study adjusts for the health status and conditions of patients, along with other characteristics, it is unlikely that the differences in hospitalizations found are due to the differences in observed patients' characteristics across primary care models. That being said, the adjustments may be imperfect in measuring the severity of the conditions. There may be important confounders that were not observed, and the recording of information about patients' health status may vary amongst physicians in different payment models.

The results suggest that characteristics such as health status and, socio-economic status are important determinants of whether a patient with an ACSC is admitted to hospital. Yet the results show that, even when adjustments are made for patients' characteristics, the type of primary care model that a patient belongs to matters in the patient's risk of an ACSC hospitalization.

Table 2.1 Descriptive Statistics for all Patients with ACSCs and by Primary Care Model

Variable	All	FFS (reference)	Enhanced-FFS	Blended Capitation	FHT
N	1,710,310	296,961	654,860	493,971	264,518
Average patient age (sd)	52.4	46.1	52.8	54.5	54.4
	(17.8)	(21.9)	(16.7)	(16.2)	(16.6)
% Male	48.7	45.5	50	48.9	48.9
Average Patient ACG® weight (sd)	0.788	0.793	0.807	0.761	0.785
	(0.868)	(0.938)	(0.846)	(0.841)	(0.888)
% COPD	3.9	3.8	3.5	4	4.9
% Asthma	16.3	26	15.6	13.2	12.8
% Diabetes	33.5	28.6	33.2	35.4	36.1
% CHF	1.8	1.7	1.5	1.9	2.2
% Hypertension	52.4	46.3	57.7	51.9	47
% Angina	3.1	2.6	2.5	3.3	5.1
% Epilepsy	2.7	3.6	2.2	2.5	3.1
Two or more ACSCs	12.4	11.6	14.7	11.1	10.1
Average RIO (sd)	7.6 (14.3)	5.9 (13.5)	4.1 (9.6)	9.1 (14.9)	15.3 (19.5)
% Income quint 1	19.9	23.2	20.3	17.9	19.2
% Income quint 2	20.6	21.2	21.3	19.7	20
% Income quint 3	20.5	19.9	21.4	19.9	20
% Income quint 4	20.5	19.1	20.6	21	21
% Income quint 5	18.1	16.1	16.3	21.1	19.3

Note: sd refers to standard error

Table 2.52 ACSC hospitalizations across models and for each condition

	FFS	Enhanced-FFS	Capitation	FHT
# patients w/ asthma	77,328	102,003	64,246	33,753
# of asthma patients w/ an ACSC hospitalization	873 (1.13%)	1,048 (1.03%)	778 (1.20%)	474 (1.40%)
# patients w/ hypertension	137,498	377,734	256,457	124,230
# of hypertension patients w/ an ACSC hospitalization	812 (0.59%)	1,761 (0.47%)	1,256 (0.49%)	695 (0.56%)
# patients w/ diabetes	85,031	217,296	174,742	95,480
# of diabetes patients w/ an ACSC hospitalization	1,244 (1.46%)	2,251 (1.04%)	2,108 (1.21%)	1,427 (1.49%)
# patients w/ COPD	11,415	22,756	19,626	12,898
# of COPD patients w/ an ACSC hospitalization	749 (2.74%)	1,206 (5.30%)	1,218 (6.21%)	986 (7.64%)
# patients w/ CHF	15,062	9,979	8,953	5,378
# of CHF patients w/ an ACSC hospitalization	331 (6.54%)	629 (6.30%)	564 (5.93%)	395 (6.84%)
# patients w/ angina	7,834	16,071	16,068	13,400
# of angina patients w/ an ACSC hospitalization	215 (2.74%)	337 (2.10%)	356 (2.22%)	309 (3.31%)
# patients w/ epilepsy	10,676	14,700	12,523	8,290
# of epilepsy patients w/ an ACSC hospitalization	394 (3.69%)	415 (2.82%)	359 (2.87%)	319 (3.85%)

Table 2.3 Odds of an ACSC Hospitalization for ACSC Patients Using FFS patients as the Reference

Variable	Odds Ratio	95% Confidence Interval
n	**1,654,106**	
FFS	**reference**	
FHT	1.06*	1.00 - 1.12
Enhanced FFS	0.78***	0.74 - 0.82
Blended Capitation	0.91**	0.86 - 0.96
Patient age	0.997***	0.996 - 0.998
Male	0.996 NS	0.96 - 1.03
ACG® weight	1.41***	1.39 - 1.42
Practice RIO	1.01***	1.01 - 1.01
Hypertension	**Reference**	
COPD	8.40***	7.99 - 8.84
Asthma	1.92***	1.82 - 2.03
Diabetes	2.37***	2.28 - 2.47
CHF	4.76***	4.45 - 5.08
Angina	2.13***	1.98 - 2.29
Epilepsy	5.65***	5.28 - 6.05
Two + ACSCs	0.88***	0.83 - 0.93
Income quint 1	**reference**	
Income quint 2	0.83***	0.79 - 0.87
Income quint 3	0.78***	0.74 - 0.82
Income quint 4	0.70***	0.67 - 0.74
Income quint 5	0.63***	0.60 - 0.67
Pseudo R^2	0.1243	
Area under the curve	**0.8012**	

Note: Significant at $p<0.001$: ***; at $p<0.01$: **; at $p<0.05$*

Chapter 3. Costs of Health Care across Primary Care Models in Ontario

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Abstract

Objectives: This paper analyzes the relationship between primary care models, on one hand, and primary care costs and total health care costs, on the other hand. It focuses on the payment mechanisms for primary care physicians and the working environment (interdisciplinary team) associated with different primary care models.

Methods: Utilization data was taken from administrative databases for a 10% sample selected at random from the Ontario adult population eligible for publicly funded health care. Analyses were conducted using generalized linear model regressions.

Results: Using the traditional Fee-for-Service (FFS) as the reference, the finding was that patients in the enhanced-FFS models had the lowest total health care costs and also the lowest primary care costs; patients in the blended capitation models had lower health care costs, but higher primary care costs. Higher primary care costs in the blended capitation models appear to be offset by lower overall health care costs.

Conclusions: The findings support the literature that associates stronger primary care with better health care systems.

3.1 Introduction

Between 1993/94 and 2009/10, the total payment to primary care physicians in Ontario increased from $1.5 billion to over $3 billion, figures that reflect the increase in revenues to physicians over the same period (Henry et al., 2012). This large increase in funding was used to reform primary care. Ontario introduced mixed payment mechanisms that included access requirements (after-hours care and on-call services) and also opportunities for physicians to increase their income (Green et al., 2009). The payment schemes introduced included financial incentives for the delivery of specific services, with a focus on preventive care. The objective was to make family medicine more attractive to medical students, thereby increasing the supply of family physicians and improving the population's access to high-quality primary care. The idea behind such policies was that strengthening primary care could strengthen the overall Ontario health care system and reduce the need for more expensive care, an idea that is supported in the literature (Bruni et al., 2009; Martin et al., 2010; Starfield, 1994; van Weel, 1996). The purpose of this study is to assess the cost implications at the patient level of the different primary care models introduced, in relation to both primary care and total health care costs. These costs are compared to the costs of the traditional fee-for-service model, which is still the payment mechanism for close to 15% of primary care physicians in Ontario.

Physician payments and methods of remuneration have been topics of increasing interest in developed countries as policy makers search for the "right" payment policy to balance physicians', patients', and payers' interests (Bekelman et al., 2014). The theoretical and empirical literature that examines the relationship between physician behaviour and payment plans suggests that the method to pay physicians can affect the quantity and quality of care delivered (Collier, 2012; Gosden et al., 2000; Gosden et al., 2001; Hennig-Schmidt et al., 2011; Sørensen & Grytten, 2003).

Prior to the reform, the main method of payment in Ontario was fee-for-service (FFS). The FFS method has been criticized for encouraging over-provision of services. Because physicians are paid for each service provided, they can control and increase their income by providing more services. The payment is not affected by the quality of the care delivered or by the ways the care corresponds to the needs of the patients (Evans, 1974). This retrospective payment method also means that the payer (in this case the Ontario government) cannot easily forecast how much it will be paying physicians. With FFS, physicians have a high degree of control over their revenues, since they can decide how many services they provide and their hours of work. Because of the incentives for a high volume of service, issues of access to care may be less pronounced than in other methods of payment, such as the capitation mechanism.

A capitation payment has the opposite incentive, i.e., the under-provision of care. The capitation payment method encourages physicians to select healthier patients for whom the cost of providing care is expected to be lower than the capitation fee. If they have no responsibility for service utilization outside of their practice, physicians may also offload the costs to other providers by referring patients to specialists more often than is necessary (Newhouse, 1984; Ellis, 1998). An alternative method is to pay physicians a salary. Salary has been seen by some as "incentive neutral" (Relman, 1988), while others consider that a salary encourages shirking (Robinson, 2001).

The method of remunerating physicians can affect how they deliver care. In a review of the literature on the relationship between primary care physician payment and clinical behaviour, Gosden et al. (2000) found that fee-for-service payments are associated with higher continuity of care and compliance with the recommended number of visits, as compared with capitation payments.

One solution proposed to deal with the theoretical issues of these payment mechanisms is the creation of blended payment approaches that combine capitation and FFS components

(Blomqvist & Busby, 2012; Leger, 2011). The reform of primary care in Ontario reflects such an approach through its development of mixed payment mechanisms.

3.1.1   Primary Care Models in Ontario

During the past decades, the Ontario government introduced a number of primary care models that move away from the traditional solo fee-for-service (FFS) practice model. Each model can be characterized by the physician payment plan, the number and types of providers working in a practice, and optional enrolment. To be enrolled with a physician, a patient must sign a "Patient Enrolment and Consent to Release Personal Health Information," in which s/he agrees to "contact [his/her] family doctor [when needing] primary care medical advice or treatment" (Ministry of Health and Long Term Care [MOHLTC], 2011). Patients also agree to the exchange of their personal information among the family doctor, other physicians in the practice, and the MOHLTC. This enrolment is linked to payments to the physician. Physicians can choose which patients they wish to enroll; patients can also decline enrolment if they wish to do so. De-enrolment can be initiated by both patients and physicians, but most of the de-enrolments are done by physicians (MOHLTC 2011), who complete a form and send it to the MOHLTC. Patients can de-enroll by letting their physician know or by contacting Service Ontario. Physicians in patient enrolment models (PEMs) are paid on a FFS basis for the non-enrolled patients that they see. The list of patient enrolment models includes: the Comprehensive Care Model (CCM), the Family Health Group (FHG), the Family Health Network (FHN), the Family Health Organization (FHO), the Blended Salary Model (BSM), the South Eastern Ontario Academic Medical Organization (SEAMO), the Rural Northern Physicians Groups (RNPGA), the Group Health Centre (GHC), the St. Joseph's Health Centre (SJHC), and the Weeneebbayko Health Ahtuskaywin (WHA).

About 6,500 of the over 7,500 Ontario primary care physicians in PEMs are in FHOs and FHGs; in comparison, the CCM and FHN models have attracted only 318 and 430 physicians

respectively (CHSRF, 2011; Kantarevic et al., 2011). The other models -- BSM, SEAMO, GHC, SJHC, and WHA-- have very few participating physicians (some of them consist of only one site). About 75% of the Ontario population is enrolled with a physician in a PEM (MOHLTC, 2013). In addition, about 3,500 primary care physicians are practicing in non-enrolment models, including the traditional FFS, and a small minority are practicing in Community Health Centres (CHCs). CHCs are community-governed organizations where physicians are part of an interdisciplinary team and are paid by salary. They were originally created in the 1970s, with limited expansion thereafter to 75 centres today at about 100 sites; these centres serve about 1% of the Ontario population. Patients are registered with the CHC regardless of the services and providers that they may see (including non-clinical services), but there is no enrolment with the CHC physician.

FFS is a "pure" payment model in the sense that physicians are remunerated for each service delivered, as defined in the Schedule of Benefits (SOB), and do not receive any other form of remuneration. The CCM and FHGs are quite similar to the FFS in the sense that physicians receive most of their payments through FFS. However, both of these models are called enhanced-FFS, and the difference, as compared to the traditional FFS, is that these models include the optional enrolment of patients, with additional payments for enrolled patients as well as on-call and after-hours requirements. One of the main differences between the FHG model and the CCM model is that in the FHG model requires to have at least three physicians in the group, whereas CCMs can be solo practices. However, the physicians in the FHG do not have to be co-located. FHGs are required to have a telephone health advisory service (THAS), and there are also slight differences in the incentive payments to CCM and FHG physicians. The Ontario Medical Association (OMA) reported that, in 2013, 35% (or 2,818) of the physicians that were in any kind of PEM were in the FHG model, which was a decline from the high of 3,651 reported in 2009 (OMA 2013). More details of the models are provided in a summary table in the Appendix.

FHN and FHO are blended capitation models. Physicians in these models are paid a capitation fee that is adjusted for the age and sex of each enrolled patient, and they are paid FFS for non-enrolled patients. Physicians also receive additional payments for reaching performance targets and providing specific services. FHNs were introduced in 2001 and did not attract many physicians; the FHO model was introduced a few years later, in 2006, with higher capitation amounts, which attracted physicians; 52% (4,266) of Ontario physicians who were in a PEM were in FHOs in 2013 (OMA, 2013). The main difference between FHNs and FHOs is in the basket of services included in the capitation rates. The basket is more comprehensive in the FHO, and this difference accounts for the higher capitation rates.

In addition to the payment methods for physicians that distinguish each of the above-described primary care models, the Ontario MOHLTC introduced Family Health Teams (FHT) in 2005, and 184 FHTs have since been created. This model is based on the delivery of care through interdisciplinary care teams. The FHT is not a payment model in the sense that physicians who are in FHTs are remunerated through the scheme of one of the remuneration models, i.e., blended capitation (FHN or FHO - most of the FHTs are FHOs), salary-based remuneration, plus bonus and incentive payments (RNPGA), or a blended salary model (BSM). The blended salary is the remuneration in community-sponsored or mixed-governance Family Health Teams, with the salary level determined by the number of patients enrolled with the physician. Only 26 FHTs are community-governed (Association of Ontario Health Centre [AOHC], 2009). The majority of the FHTs are FHOs and FHNs that apply for additional funding for the hiring of other types of providers, such as social workers, dietitians, or nurse practitioners. The physicians are also expected to contribute to the overhead expenses of running a FHT.

3.1.2   Primary Care Models and the Cost of Care Provision

There is limited research on the relationships among the characteristics of primary care practices -- either in terms of the physician payment methods or in terms of the structure of the primary

care practice -- and health care costs. In Quebec, Beaulieu et al., (2013) identified the physician remuneration method, the sharing of administrative resources, and interdisciplinary teams as factors associated with the technical quality of the primary care delivered, but the study did not look at associations with individual costs in relation to either primary care or all health care services. One study in Ontario focused on efficiency with a quality-adjusted productivity measure (Milliken et al., 2011) that found lower efficiency in CHCs, as compared to FFS, FHNs, and Health Service Organizations (HSO). The HSO was a capitation-based model that was introduced in 1973 (MOHLTC, 2002) and that was a precursor to the FHN and the FHO. HSOs have converted to one of the blended-capitation PEMs or to CHCs. The Milliken et al. study looked only at the costs of primary care, with adjustment for patients' health limited to a "poor health" assessment. This method may not have accurately adjusted for the effect of case mix. The authors did find that the most efficient practices had healthier patients, a finding that highlights the importance of adjusting for patient characteristics when examinations of efficiency are done. In Milliken et al. (2011), the outputs (numbers of patients) for determination of efficiency were self-reported by the practices, a method that may have biased the results. For instance, practices with electronic records may have had more accurate estimates than those that were using strictly paper-based records, and these record-keeping methods may not have been randomly distributed across the four primary care models studied. The study did not investigate the costs arising from utilization of other health care sectors associated with each of the four models studied in order to understand any potential spill-over effects. In addition, the study was conducted during an earlier phase of the primary care reform in Ontario, and hence does not deal with all the primary care models that currently exist.

Although higher quality in primary care has been associated with lower utilization of other (more expensive) levels of care and better patient outcomes (Starfield et al., 2003), little is known about how individual patient costs vary across primary care models. This is true both for primary care costs and total health care costs. The purpose of this study is to fill this gap and to identify how an individual's costs may be affected by the physician's primary care model. A look at both primary care and total health care costs at the individual level will also provide information about whether there is potential substitution between primary care and other care sectors, if

higher primary care costs are compensated for with lower total health care costs. Hence, even though assessment of the quality of the care is not within the scope of this research, achievement of lower total health care costs at the individual level could be a reflection of better patient outcomes. The evidence suggests that the processes of strengthening primary care with measures including higher investments and chronic disease management programs would be more than compensated for by avoidance of a population's deterioration in health and of complications that result in higher utilization of expensive health care services (Berwick et al., 2008; Bodenheimer et al., 2002; Fries et al., 1993; Lorig et al., 2001; Wagner et al., 2001).

This study examines the associations between the primary care model a patient belongs to, on one hand, and patients' primary care costs and total health care costs, on the other hand.

3.1.3   Research Questions

The purpose of this study is to compare the relationships among primary care models in Ontario and patients' costs, relative to traditional FFS physician practices, controlling for patients' characteristics. Variations in patients' primary care costs as well as costs to the health care system are examined across the primary care models and in comparison to traditional FFS practices.

The primary care models considered are the CCM, FHG, FHN, and FHO, which are mutually exclusive. The BSM, GHC, SEAMO, SJHC, RNPGA, WHA, and CHCs were excluded because they each include a very small number of patients (some only have a few hundred). The FHT is considered an additional modifier to an existing model of care that is characterized by an interdisciplinary environment; practices that are FHTs are also FHOs or FHNs. Costs are examined across primary care models.

3.1.4   Hypothesized Associations Between Primary Care Model and Cost

Effect of enhanced-FFS payment: The payment methods in the CCM and FHG models are similar to those in the FFS model, a fact that suggests that primary care costs should not be significantly different. However, enrolment supports better continuity of care, which could potentially translate into lower utilization of health care services and lower costs. Physicians in these models are also required to provide after-hours care and on call services. Patients in CCMs and FHGs could benefit from these services and improved access, as compared to FFS. These advantages could potentially translate into both less need for services in other health care sectors (such as the emergency department) and lower total health care costs.

Effect of blended-capitation payment: Patients in blended-capitation models (FHN and FHO) are expected to have higher primary care costs, as compared to patients of physicians remunerated through FFS. To offer incentives to physicians to switch from a FFS model of payment to a blended capitation model, the MOHLTC offered capitation rates that would attract physicians. The attraction would occur because the rates would be higher than the expected income from FFS payments. The empirical and theoretical literature suggests that such mixed payment models could be effective in reducing perverse incentives and controlling health care costs (Blomqvist & Busby, 2012; Leger 2011). The outcome could be lower health care costs. The incentives for preventive care and requirements for increased access could also prevent patients from utilizing other more expensive services. Higher capitation rates in the FHOs, as compared to FHNs, should also translate into higher primary care costs in FHOs, as compared to FHNs.

Effect of interdisciplinary care (FHTs): An interdisciplinary primary care environment -- represented by FHTs in this study -- should support a better quality of primary care, which could ultimately reduce costs in other health care sectors and total health care costs. Physicians can be

in a FHT only if they are already part of a blended capitation model (FHN or FHO). The FHT provides an environment where patients have improved access to a variety of health providers. The mix of providers is meant to reflect the needs of the patient population being served by the team and, hence, one could expect that the FHT would provide more comprehensive services. Because FHT patients have access to different types of providers, they are less likely to receive services elsewhere and should obtain better support for disease prevention and management. Hence, their total costs should be lower than those of non-FHT patients. In terms of primary care, the costs could be higher because of the additional funding provided by the MOHLTC for the hiring of other health care providers. Still, the additional primary care costs could be offset, since the collaborative environment may support the delegation of services from physicians to other providers. This delegation would free up time for the physicians to see more patients for the services that require the medical expertise of a physician. Hence, as compared to patients who belong to a FHN or to a FHO, patients whose physician is also in a FHT could have either higher or lower primary care costs.

3.2   Methods

3.2.1   Study Design

The hypothesized relationships were examined using administrative data from utilization of health care services for a study period of twelve months, i.e., from April 1, 2012, to March 31, 2013. Encrypted data for this cross-sectional study were obtained from the Institute for Clinical Evaluative Sciences (ICES). Using unique patient identifiers, the ICES Key Numbers (IKN), patients' enrolment data at the beginning of the study period were used to link patients to their primary care physicians and to the corresponding payment model to which the physicians belonged. Patient data were linked across all Ontario health care databases to include utilization of all health care services. Patients were assigned a primary care model based on their enrolment status. Patients who were enrolled with their physicians were considered as belonging to the model in which their physician enrolled patients. Even if physicians practice in more than one clinic and model, they can enroll patients in only one practice, which would be considered their

main practice. Patients who were not formally enrolled with a physician were considered as FFS patients. Patients of physicians who switched payment method and patients who switched their primary care physician during the study period were excluded.

The period to calculate the costs was twelve months, from April 1, 2012, to March 31, 2013. Costs C were defined as the product of the prices P and the quantity Q of the services delivered ($C=P*Q$), and price was assessed by the amount paid by the government to the provider. Total health care costs (THCC) for one individual consist of the sum of the price of each service times the quantity of each of these services used by the individual during the study period. In addition, THCC include the primary care costs related to the capitation rate when the patient is enrolled in a blended capitation model. Incentive payments cost data were not available and therefore not included in the costs calculations.

Costs were calculated using a patient's service utilization and included all the costs of services covered through the public government insurance. The Ontario Health Insurance Plan (OHIP) covers all medically necessary services, which are considered all services delivered by physicians and services delivered in a hospital setting. In addition, it covers costs of institutionalized care, including mental health inpatient beds, inpatient rehabilitation, and long-term care (LTC). In Ontario, LTC consists of nursing homes, which are called long-term care facilities, and complex continuing care (CCC), which consists of inpatient care for patients with highly complex needs. These services are free of charge to the patients, with the exception of co-payments for accommodation and meals in CCC, and additional fees if a patient wishes to upgrade from the basic rooming conditions in hospitals (for example, to get a private room). The provincial government also covers the costs of prescription drugs for all Ontarians over the age of 65 and for individuals eligible for government disability payments. The costs for each service delivered within each sector (home care, long-term care, etc.) were calculated with a method and the algorithms described below, which were developed by Wodchis et al. (2013) and the Health System Research Performance Network.

3.2.2   Study Setting and Population

The study population is a 10% sample selected at random from the adult population of Ontario eligible for health care insurance coverage. Patients were included if they had at least one physician encounter (one OHIP billing) in the 12-month period of the study, whether the encounter happened in an ambulatory care (primary care practice) or acute care (hospital) setting. Individuals were excluded from the study if they incurred zero primary care costs during the study period. Because these individuals did not use primary care services, they were considered as not part of the population of interest for this study.

Patients who died during the year were excluded from the study since the end of life (final six to 12 months) is associated with higher health care costs (Polder et al., 2006; Seshamani & Gray, 2004) that are probably strongly related to the availability of community palliative and hospice care and not determined by the primary care practice model.

3.2.3   Variables

There were two outcome variables in this study: primary care costs (PCC) and total health care costs (THCC) for the period beginning on April 1, 2012, and ending on March 31, 2013. Both of these outcome variables were calculated at the individual patient level. Primary care costs included all the OHIP billings, capitation costs, and shadow billing costs from primary care physicians. In the equations, the subscript i represents a patient; j represents the health care facility where services were delivered (since facilities may have varying costs); y represents the year. The OHIP fees in the calculations were those paid by the MOHLTC to the physicians. Physicians paid on pure FFS earn 100% of the fee, but physicians in FHOs or FHNs earn only 15% of the fees for their enrolled patients for the services included in the capitation payments.

The costs of physician services were derived from the utilization and from the fees for physician OHIP billings, shadow billings, and the capitation rates. OHIP has a database of the billings from physicians, and the database contains individual-level information on the services provided. The variables that were relevant from this database included the patient's IKN, the OHIP diagnostic code, the specialty of the physician, the date the services were provided, and the actual amounts paid to the physicians. OHIP billings can be separated according to the type of physician billing them; FFS costs from primary care physicians include all the payments made by the MOHLTC for services billed by physicians who have as their specialty family practice, general practice, emergency medicine, or community medicine. Hence, these costs included all services provided in an emergency department if the physician there had one of the above-mentioned specialties. FFS costs from specialists are the payments made by the MOHLTC for health care services billed by physicians who have a specialty different from any of those mentioned above. OHIP payments were based on the fees stated in the Schedule of Benefits (SoB). The capitation costs of patients enrolled with a FHN or FHO physician were determined by the age group and sex of the patients.

Hence, primary care costs (PCC) for the individual i were:

$PCC_i = FFS\_costs_i + shadow\_billing\_costs_i + capitation\_costs_i$ [1]

Where

$FFS\_costs_i = (Number\ of\ visits)* OHIP\ Fees\ paid\ (indexed\ by\ Billing\ Code)$ [2]

$shadow\_billing\_costs_i = 0.15*(Number\_of\_services*OHIP\_FFS)$ [3]

$Capitation\_costs_i = Capitation*Multiplier\ ^{age}_{sex} + [Capitated\ Rate*OHIP\ Fee\ Schedule]*$

$(number\ of\ visits)$ [4]

In the cases of patients who were over 65 years of age and enrolled in a FHO, the primary care costs were determined by:

$$Case\ Cost_{i,t} = Capitation(t) \times \left(Multiplier_{sex}^{age} + Old\ Age\ Multiplier_{sex}^{age}\right)$$ [5]

Total health care costs consisted of the sum of allocated payments from all the health care services utilized, including physician, hospital, long-term care, prescription drugs, rehabilitation, home care, laboratory tests, and non-physician health care professionals.

$THCC_i = physician\_costs_i + hospital\_costs_i + prescription\_drug\_costs_i + home\_care\_costs_i + long\_term\_care\_costs_i + rehabilitation\_costs_i + non\text{-}MD\_costs_i + lab\_costs_i$ [6]

Physician services included those described above for primary care physicians (PCC) and those for non-primary care physicians who bill OHIP in cases where the fees paid are based on those listed in the SoB.

Hospital costs were based on the utilization and the cost of services at the specific hospital where care was provided. Hospitalization utilization included inpatient admissions and surgical care, as well as oncology and dialysis delivered in hospital and emergency department (ED) visits. These data are recorded in two databases, i.e., the Discharge Abstract Database (DAD) and the National Ambulatory Care Reporting System (NACRS). Inpatient hospital costs were calculated with data from the (DAD) and include all hospitalizations that patients had during the study period. The NACRS database includes both scheduled and unscheduled care: ED visits and same day surgeries (SDS), as well as dialysis and cancer treatments. The unit cost in Ontario hospitals was determined as a cost per weighted case (CPWC) and is described in Wodchis et al. (2013). The Canadian Institute for Health Information (CIHI) developed a case-mix methodology, whereby individuals are assigned a resource intensity weight (RIW) value that is based on the resources used by people with similar conditions. The hospital-specific CPWC is calculated by dividing the total costs of a cost centre, for instance, for same day surgery, by the total resource utilization weights. This method takes into consideration the fact that costs may vary from one hospital to another, depending on a number of factors, such as the location or the teaching status.

Hospital_costs$_i$ included the costs for hospitalizations and the costs for planned and unplanned ambulatory care services (ED visits, same day surgery [SDS], dialysis, and oncology). The figure was determined by adding the sum of the costs for all hospitalizations to the sum of the costs of ambulatory care received in hospital:

$$Hospital\_costs_i = \sum [RIW_i(y)* CPWC^j(y)] + \sum [CACS\ RIW_i(y)* CPWC\ SDS^j(y)] \quad\quad [7]$$

where RIW$_i$ is the Resource Intensity Weight of a hospitalization, based on a patient's case-mix group (CMG), age group, age, length of stay, comorbidity level, and procedures received; CPWC^j is the hospital-specific cost per weighted case; CACS RIW is the RIW based on the Comprehensive Ambulatory Classification System, which is similar to the CMG system, but for ambulatory care.

Prescription drug costs came from the Ontario Drug Benefit (ODB) Database and were limited to patients who were eligible for the program, i.e., people 65 years of age and older, people living in a Long Term Care Home or a Home for Special Care (which is a program that provides housing, meals, and assistance with daily living for people with serious mental illnesses), people who receive social assistance or disability payments, and people registered in the Trillium Drug Program for whom the costs of the drugs are high relative to their income. The costs of prescription drugs consisted of the sum of the fees for all prescriptions filled for all the different drugs that a patient was taking. The out-of-pocket drug costs (including co-payments and/or dispensing fees) and costs covered by private insurance were not available and could not be included.

Home_care_cost$_i$ included costs per visit and costs per hour as well as a cost management fee, which was obtained based on the total case management costs of the Community Care and Access Centres (CCAC) that are responsible for the coordination and delivery of home care services by third party providers, and also based on the number of the CCAC's clients. The

management fee was calculated on the basis of the data in the financial reports that the CCACs submit to the MOHLTC.

*Home_care_cost$_i$ = Cost per Visit (y) * Number of Visits + Cost per Hour (y) * $\sum_{visits}$Number of Hours + CCAC management fee* [8]

Long_term_care_costs combine the costs from long-term care facilities (LTC), complex continuing care beds (CCC), and inpatient mental health facilities (OMHRS). These facilities have a per diem cost, which is adjusted with a case-mix index (CMI) that is specific to the type of bed (LTC, CCC, or mental health).

long_term_care_costs$_i$ = ltc_costs + ccc_costs + mental_health_costs [9]

Where:

Ltc_costs$_I$ depended on a resident's length of stay (LOS) and the per-diem cost of the LTC facility; the per diem cost included nursing and personal care (NPC), which depended on the resident's case-mix index (CMI), program and support services (PSS), raw food (RF), and other accommodation (OA). From these costs, the resident's basic co-payment (RBC) was deducted.

$$Ltc\_costs_I = \sum_{t=1}^{T}\{NPC(y)*CMI_{it}+PSS(y)+RF(y)+OA(y)-RBC(y)\}*LOS_{it}$$ [10]

A patient's complex continuing care costs depended on the patient's CMI during a period t, the length of stay (LOS) at the CMI of the period t (patients are assessed on a regular basis and the CMI can change), and the Cost per RUG Weighted Patient Day (CRWPD) of the facility:

$$ccc\_costs_i^j = \sum_{t=1}^{T}CMI_{it}*LOS_{it}*CRWPD^{\,j}(y)$$ [11]

Inpatient *mental_health_costs$_i$* were based on the length of stay (LOS), the case mix during a specific time period, which in mental health is known as the System for Classification of In-

Patient Psychiatry (SCIPP), and the cost per weighted patient day. Because the condition of a patient may change over time, the cost is assessed regularly, and the SCIPP is modified accordingly;

$$Mental\_health\_costs_i^j t = \sum_{t=1}^{T} SCIPP\_CMI_{it} * LOS_{it} * CSWPD^j(y)$$ [12]

Inpatient rehabilitation costs were calculated as a CPWC with a rehabilitation cost weight (RCW) that adjusts for the case mix. The RCW was determined by an assessment of the patient that led to a Rehabilitation Patient Group (RPG) score, which is a case-mix classification for rehabilitation patients:

$$Rehabilitation\_costs_i{}^j = RCW_i * CPWC^j$$ [13]

Lab costs were limited to lab tests billed to OHIP.

OHIP billings from other providers were from non-physicians who bill OHIP.

The explanatory variables of interest were the primary care models variables, which indicate the effect of the model on a patient's primary care and total health care costs, as compared to the costs of a FFS patient. Each primary care model is a binary variable: FFS, CCM, FHG, FHN (not FHT), FHO (not FHT), FHT-FHN, and FHT-FHO. Patients can only belong to one model and, hence, the primary care model variables are mutually exclusive.

In addition, the explanatory variables, adjusting for the characteristics of the practice and the characteristics of the patients, are explained below.

The Rurality Index of Ontario (RIO) is a continuous variable that takes a value between 0 and 100, with lower values indicating an urban location and higher values indicating rural and remote locations. The purpose of this variable is to adjust for the geographical location of the primary care practice, since the location may affect access to primary care and to health care services, including hospitals. The RIO is a measure that was developed by the Ontario Medical Association for Ontario communities (Kralj, 2009). The RIO includes the following 10 variables: travel time to nearest basic referral centre, travel time to nearest advanced referral centre, community population, number of active GPs, population-to-GP ratio, presence of a hospital, availability of ambulance services, social indicators, weather conditions, and selected services.

The patient ACG® weight 65+ is a continuous variable that adjusts for a patient's health status. It is calculated using a patient's health services utilization and is based on a reference population 65 years of age and older. The Johns Hopkins Adjusted Clinical Groups (ACG®) Case-Mix System is an algorithm developed to adjust for case mix. The ACG® system "measures the morbidity burden of patient populations based on disease patterns, age and gender" (www.acg.jhsph.org). The system goes beyond a simple count of conditions in assessing patients' needs by taking into consideration the effect of "combinations of types of disorders" (Starfield et al., 1991). It uses the ICD codes from a patient's health care utilization and takes into consideration the duration, the severity, the certainty of the diagnostic, the etiology, and specialty care involvement. A description of the methodology used in the calculation of ACG® weights can be found in the Johns Hopkins Bloomberg School of Public Health (2009). The ACG® System calculates relative weights that are based on a reference population. There are two reference populations: the under 65 (privately insured or not insured American population) and the 65 and older (Medicare-eligible population). The ACG® weight used here is the one for a reference population 65 and older. The ACG® system has been validated in multiple settings, including Ontario, where it has been used for studies in primary care (Glazier et al., 2009; Sibley et al., 2011). The ACG® weight adjustment is also considered a more valid case-mix measure than any other currently available for primary care. The ACG® weights were calculated using data on the patient's health care utilization in the 24-month period prior to the study period, with

diagnostic data from the DAD and from the billings in the Ontario Health Insurance Plan (OHIP) database.

The other explanatory variables that were used to adjust for patient's characteristics are: age (continuous variable), sex (dichotomous variable), and income quintile, based on postal codes with the lowest quintile (1) as the reference group, and binary variables for every other quintile.

3.2.4   Statistical Analysis

Multiple approaches to analysis of cost data have been proposed and compared. The most common are the OLS, with a log transformation of the outcome, and the Generalized Linear Model (GLM). The choice of a method depends on the characteristics of the data and the model, as well as on objectives in terms of interpretation. The log transformation of the dependent variable is a common approach to address the skewness that is typically present in cost data (Moran et al., 2007; Vavken et al., 2012). The difficulty with the OLS regression with log transformation is in the interpretation of the coefficients that indicate percentage changes, rather than with the incremental cost as compared to the reference in dollar value. The Duan smearing estimate (Duan, 1983) is commonly used to retransform the estimates. However, the estimator is biased in the presence of heteroscedasticity. Analysis was conducted of both primary care costs and total health care costs with log-transformed OLS regressions. The Breusch-Pagan test was used and showed that there was heteroscedasticity. Given the number of variables, identification of the source of heteroscedasticity is a complex matter. A GLM using a log link has been proposed as an alternative to analyze skewed health care costs (Baser, 2007; Manning & Mullahy, 2001). The benefit of the GLM is that is does not require retransformation and smearing correction. However, it does require specifying the distribution of the mean-variance relationship among Gaussian, Poisson, Gamma, and inverse Gaussian. The modified Park Test, as suggested by Jones (2010), was used, and the Gamma distribution was chosen. The results reported below are based on the GLM with a log-link and a Gamma family.

3.2.5   Regression Models

Multiple regressions were used to answer the two research questions using the GLM log-link with the Gamma family. The first regression modelled patient primary care costs, using primary care physicians' OHIP billings, capitation costs, and shadow billing costs and dummy variables for the models. The second analysis examined total health care costs as a function of the primary care model of the primary care physician and also of the other explanatory variables identified.

Regression models for both primary care and total health care costs were defined as:

$Cost_i = \beta_0 + \beta_1\,CCM_i + \beta_2\,FHG_i + \beta_3\,FHNnotFHT_i + \beta_4 FHOnotFHT_i + \beta_5\,FHT\text{-}FHN_i + \beta_6\,FHT\text{-}FHO_i + \beta_7 RIO_i + \beta_8\,ACGweight_i + \beta_9\,age_i + \beta_{10}\,sex_i + \beta_7\,income\_quintile_i + \varepsilon_i$

Where: $Cost_i$ is either the primary care or the total health care cost of the services for patient i for a 12 month period; β_0 is the intercept; CCM_i, FHG_i, $FHNnotFHT_i$, $FHOnotFHT_i$, $FHT\text{-}FHN_i$, and $FHT\text{-}FHO_i$ are dichotomous variables for the primary care models, using FFS as the reference group; RIO_i is the value of the RIO of the practice the patient i belongs to, and β_6 is its relationship with the costs; age_i, sex_i, and $income\_quintile_i$ are the adjustments for the patient's age, sex, and neighbourhood income quintile; ε_i is the error term for patient i.

3.3 Results

The sample contained 1,133,645 observations, after exclusion of people who had died (16,712), people with no primary care costs (40,617), and people from "other" primary care models (21,267), i.e., CHG (110); CSA (7,392); GHC (4,799); RAN (7,857); SMO (654); and STJ (455). Table 1 describes the characteristics of the patients in the sample as a whole and according to primary care model, including the average costs, broken down by health care sector and types of

services. The majority of the people in the sample belonged to a FHO (45%) or a FHG (30%). The average age of patients was 40, and the ages ranged from 34 in the FFS model to 42 in the CCM model and the FHN-not-FHT model. Practices that are FHNs tend to be located in more rural or remote areas with substantially higher RIOs: 34 for FHN-not-FHT and 38 for FHT-FHN, compared to an average of eight for the whole sample. Health status, as measured by the average ACG® weights, was the highest amongst FHT patients; the measurements varied from 0.480 for FHT-FHN patients to 0.575 for the FFS patients. Patients in blended capitation models are generally wealthier; these models include the highest proportions of patients in the higher income quintiles. Higher proportions of patients in the lower income quintiles were found in the FFS and not-enrolled patient categories. Given the fact that people in lower income quintiles are generally less healthy, the average ACG® was examined by model and income quintile. The results are reported in the Appendix and suggest that people are increasingly healthier in higher income quintiles.

In terms of costs, the highest health care costs are hospital costs, followed by physician costs. This finding about costs is true for the whole sample and across all models of care, except for FHG patients, who have higher physician costs than hospital costs. Hospital costs and drug costs are highest for patients who belong to FHNs.

Table 3.1. Descriptive Statistics and Costs of Patients by Primary Care Model

Variable	Total	FFS (reference)	Not enrolled	CCM	FHG	FHN not FHT	FHO not FHT	FHT-FHN	FHT-FHO
N	1,133,645	90,112	96,945	37,554	345,783	5,691	338,345	25,767	193,448
Mean patient age	39.8 (22.3)	33.7 (23.7)	35.9 (21.9)	41.7 (21.6)	39.9 (21.6)	42.4 (23.2)	41.5 (22.3)	40.4 (23.0)	41.0 (22.6)
% Female	52.7	50.9	50.6	52.4	53.5	52.9	52.7	53.0	53.3
Mean ACG® weight	0.521 (0.711)	0.575 (0.835)	0.513 (0.716)	0.550 (0.709)	0.546 (0.703)	0.523 (0.767)	0.504 (0.691)	0.480 (0.690)	0.486 (0.690)
Mean RIO	8.0 (14.6)	5.0 (12.8)	6.5 (13.5)	8.7 (16.3)	3.5 (8.0)	34.0 (16.9)	8.6 (14.3)	37.6 (25.9)	11.9 (16.2)
% Income quint 1	18.1	22.3	21.2	20.9	18.3	15.4	16.1	18.9	17.0
% Income quint 2	19.3	20.7	19.6	22.4	19.8	17.6	18.3	20.6	18.9
% Income quint 3	20.2	19.2	20.0	20.7	21.1	19.9	19.5	18.8	20.2
% Income quint 4	21.7	19.8	20.3	20.0	22.0	23.3	22.2	20.3	22.0
% Income quint 5	20.4	17.5	18.5	15.6	18.5	23.6	23.6	20.5	21.5
Mean Hospital Costs: SDS, inpatient, cancer, ED, dialysis	$765 (4,895)	$873 (5,765)	$825 (5,312)	$791 (5,660)	$676 (4,544)	$989 (4,595)	$770 (4,772)	$906 (4,796)	$802 (4,908)
Mean Physician costs: OHIP billings, shadow billings, capitation	$690 (1,228)	$716 (1,374)	$672 (1,286)	$676 (1,197)	$687 (1,222)	$664 (1,092)	$706 (1,239)	$608 (1,045)	$679 (1,143)
Mean Long Term Episodes Costs: CCC, LTC, OMHRS	$163 (2,552)	$177 (2,670)	$303 (3,524)	$271 (4,540)	$228 (3,739)	$174 (2,599)	$154 (2,464)	$207 (2,901)	$159 (2,523)
ODB Cost	$318 (2,065)	$319 (1,737)	$324 (4,180)	$332 (1,400)	$300 (1,730)	$389 (1,804)	$320 (1,570)	$361 (1,840)	$333 (2,057)
NRS Cost	$34 (1,059)	$33 (1,006)	$32 (1,040)	$27 (820)	$30 (924)	$43 (1378)	$38 (1,196)	$29 (1,462)	$35 (1,030)
HC cost	$119 (1,389)	$147 (1,890)	$127 (1,446)	$105 (1,211)	$103 (1,369)	$141 (1,236)	$119 (1,253)	$137 (1,338)	$132 (1,390)
Lab costs	$66 (109)	$66 (112)	$67 (112)	$74 (112)	$75 (116)	$43 (87)	$63 (105)	$48 (97)	$58 (102)
Non MD costs	$22 (133)	$22 (140)	$25 (161)	$21 (122)	$20 (124)	$27 (151)	$23 (134)	$24 (128)	$23 (132)
Mean Total health system costs	$2,300 (8,848)	$2,531 (10,015)	$2,608 (11,175)	$2,297 (9,441)	$2,119 (8,100)	$2,612 (8,665)	$2,304 (8,524)	$2,427 (8,684)	$2,334 (8,685)
Mean PC costs	$288 (416)	$274 (605)	$268 (532)	$269 (372)	$278 (426)	$305 (378)	$307 (349)	$297 (377)	$293 (333)

Physician costs are highest for FFS patients, followed by the physician costs of FHO-not-FHT patients. The costs of long-term episodes are highest for not-enrolled patients. Hospital costs are the highest for FHN patients.

The average total health care cost was $2,300, and varied from $2,119 for patients of FHGs to $2,612 for FHN-not-FHT patients. The average primary care cost was $288, and varied from $268 for not-enrolled patients to $307 for FHO-not-FHT patients.

The sample size was reduced to 1,094,687 because of missing data for the GLM regression, using a gamma distribution and log-link for health care costs and primary care costs. The marginal effects in dollars of the explanatory variables were computed from the GLM models, using the method described by Jones et al. (2013) and are reported in Table 2. The marginal effects of the explanatory variables are described below.

Table 3.2 The Average Marginal Effect of Primary Care Models on Primary Care Costs and on Total Health Care Costs

Variable	Primary Care Cost (in $)	Total Health Care Cost (in $)
N=1,094,687		
Practice Characteristics:		
FFS	reference	reference
Not enrolled	-5	130*
Enhanced FFS – CCM	-32***	-658***
Enhanced group FFS - FHG	-13**	-667***
FHN not FHT	0.1	-446***
FHO not FHT	16***	-485**
FHT – FHN	2	-433***
FHT - FHO	5	-392***

Practice RIO	0.3***	7***
Patient Characteristics:		
Patient age	4***	61***
Patient female	48***	-101***
ACG® weight	128***	2,947***
Income quintile 1	Reference	Reference
Income quintile 2	-17***	-325***
Income quintile 3	-21***	-436***
Income quintile 4	-27***	-517***
Income quintile 5	-33***	-607***

***indicates significance at $p < 0.001$; **indicates significance at $p < 0.01$; *indicates significance at $p < 0.05$

3.3.1   Effect of Primary Care Model

The effect of the primary care model on a patient's costs is measured through the variables CCM, FHG, FHN-not-FHT, FHO-not-FHT, FHT-FHN, and FHT-FHO. Compared to FFS patients, primary care costs are on average $32 lower for CCM patients and $13 lower for FHG patients. They are $16 higher for FHO-not-FHT patients. The primary care costs of patients who are not enrolled but who are seeing a physician who is in a patient enrolment model are not significantly different from those of patients seeing FFS physicians. Compared to FFS patients, health care costs are lower on average by $658, $667, $446, $485, $433, and $392 for CCM, FHG, FHN-not-FHT, FHO-not-FHT, FHT-FHN, and FHT-FHO patients respectively. They are $130 higher for not-enrolled patients.

3.3.2   Effect of Patient Characteristics and Practice Location

The statistical models controlled for the practice location (RIO) and for patients' age, sex, ACG® weight, and income (neighbourhood income quintile). All of these variables were highly significant in predicting both health care and primary care costs in both the OLS-log and GLM specifications.

Primary care costs increase by $0.3 with each unit on the RIO, i.e., with higher rurality, and total health care costs increase by $7. Primary care costs increase with age, by $4 per year for primary care costs and by $61 in the study period (April 1 2012 to March 31 2013) for total health care costs, irrespective of the practice model the patient's physician belongs to. Being a female is found to be associated with an increment for primary care costs of $48 and a decrease of $101 for total health care costs. Each increase in ACG® unit of measure is associated with an increase of $2,947 in total health care costs and an increase of $128 in primary care costs. Despite adjustments for age, sex, and ACG® weight, the neighbourhood income quintile a patient belongs to remains a highly significant predictor of costs, with a decrease in both primary care and health care costs for each higher income quintile. The total health care costs for patients in income quintile 2 are $325 lower than the costs for patients in the lowest quintile (1), and the costs of patients in the highest income quintile (5) are $607 lower than the costs for patients in quintile 1. The effect is weaker for primary care costs, but the cost remains between $17 and $33 lower for income quintiles 2 to 5, as compared to quintile 1. This means that patients from lower income neighbourhoods have higher primary care and health care costs, as compared to patients from higher income neighbourhoods.

3.4 Discussion

The results suggest there are statistically significant differences in both health care and primary care costs across primary care models. A practice's RIO and patient characteristics (socio-demographics, socio-economic status, and health status) were also significant factors in predicting both primary care and total health care costs.

3.4.1   Primary Care Payment Method and Total Health Care Costs

Patients whose physicians were remunerated through a mixed-payment model (CCM, FHG, FHN, or FHO) had lower total health care costs, as compared to FFS patients.

Enhanced-FFS payments (CCM and FHG) were associated with the lowest total health care costs, and blended capitation payments (FHN and FHO) were associated with health care costs on average over $600 lower than those of FFS patients. These results diverge from the absence of statistically significant difference found by Conrad et al. (1998) when they examined the relationship between the method of physician compensation, the costs, and the utilization, on one hand, and the yearly per member cost, the number of physician visits, and the number of hospital days in medical groups in Washington state, on the other hand. However, Conrad et al. (1998) decided not to include the ACG® weight because of its codeterminacy with utilization. In the statistical models in the present study, the costs were calculated as the product of the quantity of services and the prices of those services. Hence, in the present study, utilization is reflected in the outcomes variables. The current study also considers that the method of payment could affect utilization, based on the premise that many health care decisions are made by physicians rather than by patients (Fisher et al., 2009; Sirovitch et al., 2008).

The results of the present study appear to contradict the theoretical literature that suggests that a capitation payment provides an incentive for an under-provision of care and a shift towards other levels of care that are more expensive, such as specialists' care or hospital care (Allard et al., 2010). In fact, Allard et al. (2010) suggest that FFS would be the optimal payment system, if primary care physicians all had a high diagnostic ability and were relatively altruistic in their desire to provide high-quality care, or if patients' outcomes were measured and considered in the payments. However, it is more likely that there is heterogeneity amongst physicians in relation to those two aspects. In addition, in a context such as the one in Ontario, where primary care physicians have various payment options, physicians may choose the primary care model that is most beneficial in relation to their skills and altruism levels, given the characteristics of their

patient population. In fact, other researchers who examined physicians' levels of altruism found heterogeneity and differences in optimal payment methods, depending on a physician's altruism (Chalkley & Malcomson, 1998; Choné & Ma, 2011; Godager et Wiesen, 2013; Liu & Ma, 2013).

It is remarkable that FFS patients are different from the general sample (descriptive statistics in Table 3.3); they are younger, more likely to be males, and have higher morbidity (highest ACG® weight) on average. They are more likely to be from neighbourhoods in the lowest income quintile. They are also different from the patients who see physicians in patient enrolment models but who are not enrolled. Members of this not-enrolled group have the highest long-term episodes costs, yet the lowest primary care costs. The cost data suggest that the non-enrolled patients may be more likely to be residents in long-term care facilities. The patients in both of these groups are likely to be more at the extremes in terms of their situations. A majority of them are young and healthy, and a minority are very sick, as suggested in a study conducted by Rudoler et al. (2015). They may reflect a selection process amongst physicians who choose to not enroll patients who would be more profitable when they are not enrolled and physicians who may not enroll a patient who comes to visit just once. Patients who see FFS physicians (who probably work in walk-in clinics) may not be actively seeking a regular source of care (for instance, young males).

3.4.2   Primary Care Payment Method and Primary Care Costs

Compared to the FFS patients, average primary care costs are higher for patients in blended capitation models and lower in enhanced-FFS models. The higher primary care costs for patients in blended-capitation models could appear counterintuitive in relation to the theoretical literature, which supports capitation remuneration as a form of cost containment (Leger, 2011) and in relation to a US study that found lower costs associated with capitation payment (Kralewski et al., 2000). A potential explanation may be the capitation fees and the fact that these were determined with a policy objective of attracting physicians to the blended-capitation models. This objective was particularly the case with the FHO. Hence, the higher primary care costs in

blended capitation models are in line with the context and the aim of the government, i.e., to induce physicians to switch from FFS practices to blended-capitation payment models.

The reform of primary care was a way for the Ontario government to address two inter-related issues: access to and the quality of primary care and a shortage of family physicians/general practitioners (Kralj & Kantarevic, 2012). The FHNs with capitation payments were not originally perceived positively as attractive options for the majority of physicians (Hunter et al., 2004), but the potential for increased earnings that became more apparent later on and even more so in the FHO model eventually attracted physicians. The basket of services is larger in the FHO model with 132 fee codes (compared to 69 in FHNs), and the implication is higher capitation rates in FHOs. The difference in rates increases with the age group of the patient (Sweetman & Buckley, 2014). Age and sex adjustments to the capitation rates are meant to reflect the expected primary care utilization of patients in each age and sex group; these adjustments mean that the rates should be close to the FFS payments a physician would be expected to receive for the patient. However, this closeness appears not to be the case when adjustment for health status is made with the ACG® weights, which were not used in determining capitation payments. Similar to the findings of Sibley et al. (2001), the raw data here did show that CCM and FHG patients had a higher average ACG® weight (i.e., higher morbidity) than FHN and FHO patients, and this information does suggest a selection bias. The differences in patient costs could be related mostly to the fact that the payments do not take into consideration patients' morbidity with a measure such as the ACG® weight.

An earlier study on the primary care reform in Ontario examined physicians' income and found that primary care physicians who switched experienced an increase of about 30% amongst those who went into FHNs and 12% amongst those who went into FHG practices (Hogg et al., 2007). FHOs had not yet been created when the study was done. A more recent Ontario study also found an increase in government payments, i.e., primary care costs, to physicians after they switched from a FFS-based model to a blended-capitation model (Jaakkimainen et al., 2013).

The reform transformed the provision of primary care by encouraging physicians to work in groups and in interdisciplinary teams, and new funding improved the remuneration of primary care physicians. Given these objectives, higher costs of primary care for FHO and FHN patients are a logical result of a policy aimed at attracting medical students into family medicine and into these primary care models in particular. Capitation-based payments offer the advantage for the funder, i.e. the Ontario government, of higher predictability of the costs, as compared to FFS. However, a prospective payment also means that physicians have to take on the risk burden of the possibility that patients might require more care than was expected, and more care than the care covered by the capitation rates. Such a risk could lead physicians to select healthier patients. A previous attempt to introduce capitation with the Health Service Organization model in Ontario proved to be a failure mainly because of the lack of structure and monitoring of physicians' work (Gillett et al., 2001), but also because physicians want to be rewarded for taking some of the burden of risk from the government. This expectation of reward meant that the newer blended-capitation models had to come with higher payments in order to be successful and attract physicians.

3.4.3 Patient Characteristics & Costs

Costs increase with a patient's age, a finding that is consistent with results found elsewhere (Conrad et al., 1998). Lower total costs for females are surprising. These demographic factors alone have been considered as poor predictors, as compared to diagnostic data (Fowles et al., 1996), and the results in this study also show the importance of adjusting for health status, in light of the significant effect of the ACG® weight on health care costs and on primary care costs. Even when adjusting for health status, socio-economic status, which is measured here by the neighbourhood income quintile, is still a significant determinant of costs. This result is aligned with studies that find higher health care utilization, including more primary care visits, in an urban population in Canada (Roos et al., 2005) and longer hospital stays for patients of lower socio-economic status in a hospitalized population in the United States (Epstein, 1990). These

findings suggest that socio-economic status affects health care utilization beyond the factors that can be measured through traditional case-mix adjustments (age, sex, ACG® weight). This study included only costs for health care services that are publicly insured by the Ontario government. Some costs, such as drug costs, are covered only for people of lower income. This kind of coverage would partly explain why people in lower income neighbourhoods would have higher health care costs.

3.4.4   Practice Characteristics & Costs

Health care and primary care costs increased with rurality. These results appear to contradict findings about the lower utilization of health care services found amongst older veterans in New England. This apparent contradiction can be explained by the reduced supply of and longer travel distance to U.S. health care services that are federally funded (Weeks et al., 2006).

Potential explanations also include higher prices of services (with higher payments to providers) and different types of services being utilized. The government of Ontario established the Northern Physician Retention Initiative (NPRI) to "support recruitment and retention of physicians in Northern Ontario" (MOHLTC, 2014); many rural communities also have financial incentives as part of their recruitment and retention strategies (Jutzi et al., 2009), and these incentives could potentially increase the prices of services. Some primary care physicians in Northern areas are also required to work in hospitals, a requirement that suggests that they could be less available to their primary care clients and/or see them in the hospital setting instead of in the primary care setting. Because overhead costs in the hospital are higher, delivery of care in a hospital instead of in a clinic could contribute to higher costs.

The distances that patients need to travel to access health care providers may translate into the use of different levels of care in decisions made by both patients and physicians. For instance, patients may be more likely to use hospital services for minor health issues if there are no clinics or pharmacies open that meet their needs. In an urban setting, a physician may be less likely to

admit a patient, knowing that the patient can come back to the hospital easily if the situation worsens. In a rural context, patients are more likely to be admitted and to stay in hospital longer because of reduced access and a lower supply of community-based services. Physicians may need to wait for the patient's condition to improve more before discharge if home care and other community services are not available in the patient's community. Hence, rurality may affect physicians' decisions about utilizing more costly services, and these decisions would in turn increase health care costs.

3.4.5   Interdisciplinary Care and Costs

Interdisciplinary care is measured in terms of belonging to a FHT. To understand the effect of FHTs, it is necessary to examine the marginal effects of FHT-FHN and FHT-FHO patients in relation to the marginal effects of the FHN-not-FHT and FHO-not-FHT patients. In terms of primary care costs, the FHO-not-FHT patients cost on average $16 more than FFS patients, whereas FHT-FHO patients have primary care costs that are not significantly different from those of FFS patients. This result suggests that, for FHO patients, belonging to a FHT is associated with lower primary care costs than not belonging to a FHT. . Amongst FHN patients, there is no difference between FHT and not-FHT patients, and it should be noted that there is only a small number of FHN-not-FHT patients. It should be noted that the information about the additional funding provided by the MOHLTC to FHTs was not available, and, hence, the primary care costs of FHT patients are under-estimated.

However, there are differences in the total health care costs. FHN-not-FHT patients have total health care costs that are $446 lower than FFS patients; for FHT-FHN patients, the decrease is only $433. But the difference is more important for FHO patients. The FHO-not-FHT patients have total health care costs that are $485 lower than FFS patients, and the FHT-FHO patients' total health care costs are, on average, only $392 lower than those of FFS patients. This finding contrasts with the finding of a study in Quebec, where a team-based primary care model was

associated with lower health care utilization and costs (Strumpf et al., 2013). The fact that the Strumpf et al. (2013) study is longitudinal and attempts to estimate causal effects may also account for some of the differences in this analysis. Another factor to consider is that, in 2012, many FHTs were still quite new, and this is particularly the case for the FHO, which is a newer model than the FHN. There may be higher costs for FHT patients related to the time when the practices were established, and these higher costs might disappear over time.

The results suggest that costs (both primary care and total health care costs) vary significantly across the different payment methods of the primary care models in Ontario, after adjusting for other patient and practice characteristics. The method used in this study does not allow a causal relationship to be specified between payment and physician behaviour, since there may be selection bias on the part of physicians that is not addressed here. In a study by Grumbach et al. (1998), physicians admitted to feeling pressured by financial incentives in a way that may affect patient care and also reported being more satisfied when incentives were related to the quality of care or to patients' satisfaction, as opposed to being targeted to productivity.

3.4.6   Limitations

The limitations of this study include those related to the availability and quality of the data. One important limitation of this study is that it was not possible to include all the primary care costs for FHTs, and, hence, these were underestimated. Another underestimation was in drug costs; the data for drug costs were taken from the ODB, and the ODB covers only costs for people 65 and older, residents of long-term care facilities or a home for special care, people receiving social assistance, and people registered through the Trillium Drug Program (eligible only if their drug costs are considered high relative to their income). The study did not include the drug costs from out-of-pocket payments and costs that were covered by private insurance companies (most adults working full time would have private insurance that covers the majority of the drug costs). This lack of data may have biased the results, since patient characteristics varied across models, and

income and age were not equally distributed. The missing drug costs would be more important for some models (those who serve wealthier patients and have a lower proportion of seniors) than for others.

The study did not consider some aspects of the utilization of primary care, such as the number of visits and, hence, cannot speak to any potential relationship between primary care costs and the volume of services received by the patients. A review of the literature on primary care physician payment and physicians' clinical behaviour found that FFS physicians had a higher number of visits and better continuity of care, but fewer hospital referrals and repeat prescriptions, as compared to physicians on capitation. For FFS physicians, there was lower patient satisfaction with regard to access to care, as compared to salaried physicians (Gosden et al., 2000). However, the payment methods to physicians are expected to affect health care service utilization, and, hence, the inclusion of utilization may have affected the capacity to assess the association between costs, on one hand, and primary care models and physician payment methods, on the other hand.

This study did not include physician characteristics. The age of the physician has been found to be a determinant of patient costs, which were lower for older physicians in the United States (Conrad et al., 1998). Recent Ontario-based research suggests that physicians self-select themselves into different models (Rudoler et al., 2014). Hence, physicians may have chosen the primary care models in which they wished to practice on the basis of their preferences and practices styles in order to maximize their utility, given the structures and payment plans in each primary care model.

There were limits to the data available about patient characteristics, and this study could not control for factors such obesity or inactivity, which have been associated with higher health care costs (Goetzel et al., 1998; Quesenberry et al., 1998). However, the main effect of these factors is their negative impact on one's health; i.e., the higher costs are largely explained by the

prevalence of chronic conditions (Goetzel et al., 1998; Quesenberry et al., 1998), which were controlled for with the ACG® weight.

3.5 Conclusions

The general factors affecting health care costs are consistent with those reported in the literature, with the patient's ACG® weight, i.e., the measure of health status, being an important factor in predicting total health care and primary care costs. The results also show that costs increase with the age of the patient and decrease with each higher income quintile. Total health care and primary care costs increase with a higher RIO. Both primary care costs and total health care costs decrease according to the wealth of a patient.

After controlling for these variables, there are still significant differences in total health care costs and in primary care costs across primary care models. Total health care costs are significantly lower for patients enrolled with physicians in all the mixed payment models (CCM, FHG, FHN, and FHO), as compared to FFS patients. For primary care costs, CCM and FHG patients have significantly lower costs than those in the reference group (FFS), whereas FHO-not-FHT patients' primary care costs are higher than those in the reference group.

The results of this study suggest that the payments in blended-capitation models, i.e., FHNs and FHOs, are higher, as compared to the costs of providing primary care to patients in an enhanced-FFS model (CCM or FHG). The results are consistent with the expectations of higher primary care costs in blended-capitation models, given their objectives and the policy environment in which they were implemented. This study did not look at other outcomes of care, such as patient satisfaction, or other potential benefits, such as reduced waiting times for patients as a result of an increased supply of primary care physicians in Ontario or better quality of care. Li et al.

(2014) found that pay-for-performance incentives did increase the provision of some primary care services by Ontario physicians.

The objective of this study was not to establish a causal relationship between payment model and costs, but instead to establish whether there were differences in costs at the primary care and health care levels. The study provides insight about a potential substitution; although primary care costs in some models are higher than those of FFS, the total health care costs are much lower than those of FFS patients. The information is valuable in the sense that finding these differences in costs complements other studies that compare Ontario primary care models in relation to the quality of care. For instance, the finding was that patients in FHO-not-FHTs had higher primary care costs, as compared to FFS patients and also as compared to enhanced-FFS patients. In parallel, Kiran et al. (2014) found that the quality of diabetes care was higher for patients in capitation models; Liddy et al. (2011) had similar results in terms of a lower quality of care in the prevention of cardiovascular diseases in practices where physicians were remunerated through FFS, as compared to blended capitation and salaried physician practices. Hence, the results do not mean that the reforms in payment models affected physicians' behaviours and costs. However, changes to primary care physician compensation may need to be carefully thought through and aligned with the goals of a policy. The higher total health care costs of FFS patients and not-enrolled patients do raise questions about whether the higher health care costs of these patients reflect their insufficient access to the primary care services that they need.

The findings raise questions that were not in the scope of this study, but that would be interesting to address in future research. Beyond the issues raised by cost differences, it appears that FFS and not-enrolled patients are different from enrolled patients. This difference leads to a question about what makes people not enrolled. Members of this group appear to be heterogeneous and to have average total health care costs higher than the costs of patients in most of the other models. The fact that the average ACG® weight is the highest among FFS patients is also a concern. The high average weight suggests that people with the highest morbidity may be experiencing difficulties in obtaining a primary care provider.

The current Ontario context offers physicians a choice regarding their payment method, which they can align with their practice styles and their own preferences. The finding here is that offering physicians choices has a price in the sense that costs are higher in some models (blended capitation) and lower in others (enhanced-FFS). Yet, overall, an increase in funding, with incentives for improved access and quality, appears to have a positive effect on total health care system costs. The results support the association between stronger primary care and high-performing health care systems.

Chapter 4. Efficiency of Ontario Primary Care Physicians: A Stochastic Frontier Analysis

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Abstract

Objective: This study examines the efficiency of Ontario primary care physicians. The aim is to analyze the relationship between the primary care model that a physician belongs to and the efficiency of the physician.

Methods: Survey data were collected from 183 self-selected physicians, within the context of a larger study, through questions about the physician's practice. The survey data were linked to administrative databases to capture the provision of services and the characteristics of the patients served. Efficiency scores were calculated from a stochastic frontier analysis, using an exponential distribution of the error term. Physicians were categorized as being in Fee-For-Service (FFS), in enhanced-FFS, in blended capitation models, in salaried models, and in interdisciplinary teams. FFS physicians were the reference group. The labour input was the weekly hours that physicians reported spending on direct patient care. Two outputs were examined in distinct analyses, i.e, the number of patients seen and the number of visits in a 12 month period ending June 30, 2013. The analyses were adjusted for the duration of the consultations, for patient demographic and socio-economic characteristics, and for the geographical location of the physician's practice.

Results: Because of missing data, only 165 physicians were included in the analyses. The average efficiency was 0.72 for both outputs. When the output considered was the number of patients, physicians in blended capitation and in salaried models had a lower level of efficiency.

When the number of visits was considered as the output, physicians in blended capitation and in interdisciplinary teams (where physicians are also remunerated through blended capitation) had the highest average efficiency (0.74 for both groups). The average neighbourhood income quintile, the lengths of a regular consultation and a long consultation, and the percentage of consultations that were long were significant variables in the regression analyses for both output measures. Longer "long" consultations were associated with fewer patients seen, but not with the number of visits. A higher average age of a physician's patient population was associated with a lower number of patients seen, but not with the number of visits. A higher proportion of female patients was associated with fewer visits, but not with the number of patients seen.

Conclusions: The characteristics of a physician's patient population, along with the duration of consultations, affect outputs produced by physicians and their efficiency. Even when adjustments are made for these factors, there are still significant differences across the primary care models. There is a wide variability in the efficiency of physicians on both output measures, from 0.05 to 0.93 in the number of patients seen, and from 0.06 to 0.94 in the number of visits. The average score (0.72) suggests that there is room for improvement.

Key words: efficiency, physician remuneration, stochastic frontier analysis, primary care, productivity

4.1 Introduction

Concerns over growing health care expenditures have led to interest in increasing the efficiency of health care services, particularly in developed countries such as Canada (Hollander et al., 2009). Efficiency can be defined as the relationship between the observed ratio of outputs to inputs of a unit (such as a physician), compared to an optimal ratio. The optimal ratio is defined by the maximum output that could be produced with the same quantity of inputs or to the fewest inputs that could be used to produce the same level of output (Khumbakar et al., 1991; Palmer & Torgerson, 1999).

Research on the efficiency of primary care physicians has emphasized productive efficiency, as opposed to technical efficiency or allocative efficiency. Productive efficiency is concerned with finding the right intervention that optimizes the resources used in the production of maximum health outcomes.

Various factors can affect the productive efficiency of primary care physicians, including remuneration methods and the organizational characteristics of the primary care practice. Understanding the effect of these various factors is important to the process of building an environment that fosters the efficiency of primary care physicians.

In 2001, the Ontario government began a reform of the primary care sector through the gradual introduction of new primary care models. The new models were characterized by mixed payment mechanisms for physicians, with features that included incentives for the delivery of preventive services, group and interdisciplinary teams, enrolment of patients with the physicians, and after-hours access requirements.

The ways physicians are paid and organized can affect how they practice and their efficiency in the delivery of the care. Given the context of financial constraints on health care, there has been a growth in the measurement of efficiency in Ontario's health care sectors. However, there is limited evidence about the efficiency of primary care physicians in relation to the new models that have been implemented since the beginning of the reform. The purpose of the present study is to examine the relationship between the primary care models and the productive efficiency of primary care physicians.

4.1.1   Measuring Efficiency

There are two main methods used in health care to analyze efficiency: data envelopment analysis (DEA) and stochastic frontier analysis (SFA). The former is the one most commonly used in the health care literature. Both of these methods are based on determination of a production function and then examination of the observed outputs against the function. One of the main differences between the DEA and the SFA is in the way the production function is determined. DEA is a non-parametric method that uses the data from the best performers to determine the production function. Any departure from the curve of the production function is considered inefficiency. Although DEA has the advantage that it accommodates multiple inputs and outputs, the number of these may affect the number of units on the production function curve. For instance, if there are units that produce four different outputs, while others produce fewer types of outputs, there will be at least one unit for each different set of outputs on the production function curve.

Figure 4.1 provides a visualization of a production frontier based on the DEA method. In the case of a production function (as opposed to a cost function), all the observations that are not on the curve are underneath the curve and are considered inefficient because the curve is determined by the units that are the most productive.

Figure 4.1. Production Function in DEA
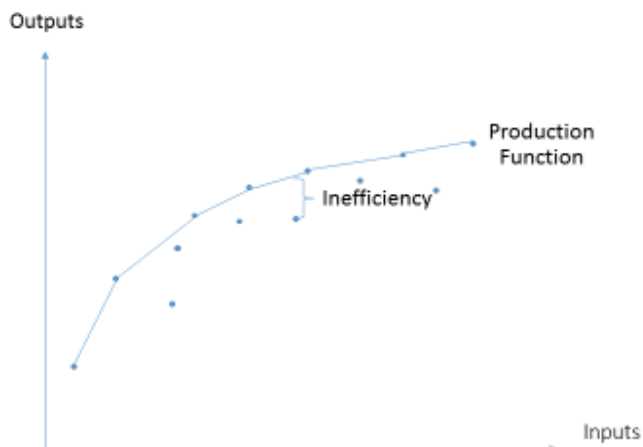
SFA is a parametric method in which the researcher has to determine the functional form of the production function. In SFA, the error term is composed of two components: inefficiency and noise: $e_i=u_i+v_i$ (Battese & Coelli, 1995). DEA has generally received more attention because it does not require defining a functional form (Amado & dos Santos, 2009; Andes et al., 2002; Bates et al., 1996; Ferreira et al., 2013: Luoma et al., 1998; Milliken et al., 2011; Rosenman & Friesner, 2004; Szczepura et al., 1993; Zavras et al., 2002). Use of SFA in the health care literature is more recent, and this method has the benefit of assessing the effect of covariates on the efficiency scores (Schmacker & McKay, 2008).

Figure 4.2 provides a graph where the production function is determined with the SFA method. In the graph, there are observed values below and over the production curve. The SFA method requires determination of the form of the production function curve and the form of the noise component in order to determine the inefficiency component.

Figure 4.2. Production Function in SFA
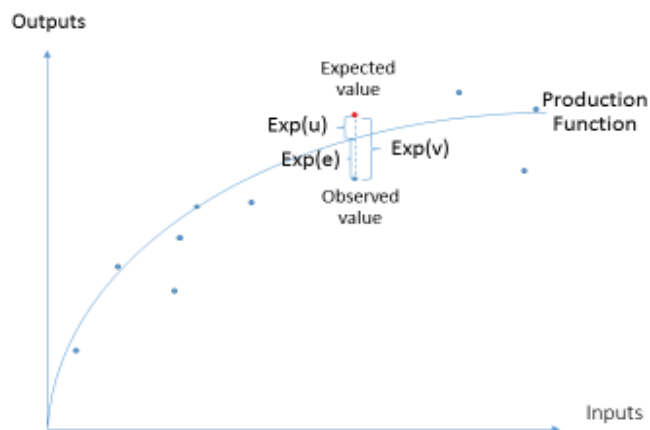
4.1.2   Efficiency Measurement in Primary Care

Efficiency measurement requires the identification of outputs and inputs. Physician outputs are generally counted in terms of the number of services or consultations provided or the number of patients seen (Bates et al., 1996; Milliken et al., 2011; Rosenman & Friesner, 2004; Schmacker & McKay 2008; Zavras et al., 2002). Some researchers, taking advantage of the fact that DEA allows for multiple outputs, categorized the types of consultations, such as family planning, home visits, or visits in the hospital (Amado & dos Santos, 2009). Other studies used revenues generated (Andes et al., 2002; Pope & Burge 1996; Thurston & Libby, 2002) or visits to various types of providers in a health care organization (Ferreira et al., 2013; Luoma et al., 1998). Still another approach is the use of the number of targets achieved, such as the percentage of physicians achieving high rates of immunizations or cancer screenings with their patient population (Szczepura et al., 1993; Giuffrida & Gravelle, 2001).

The outputs chosen may reflect the objectives and context of the study. In a context where primary care organizations are aiming to maximize profitability, it is logical to examine the revenues generated. Using revenues generated also allows the combination of all the outputs (vaccinations, check-ups, etc.) into one measure. From the perspective of policy makers who want to increase access to primary care providers, the desired objective is to maximize the provision of necessary services to patients. Within this context, a distinction can be made between the number of patients seen and the number of services provided. Although these are both volumes, they measure different aspects of care. The number of patients reflects how many people had at least one visit with the provider and, hence, had access to a primary care physician, whereas the number of services can be considered as reflecting the intensity of care provided to the patients seen.

The diversity of the inputs selected may also depend on the context. Inputs are generally categorized into labour, capital equipment, and office space. However, many studies identified alternate variables as proxies because of limited data availability. In addition, the way of measuring inputs varies from one study to another. One of the important differences is in the use of a count of the number of full-time equivalents (FTE) for labour inputs (Amado & dos Santos, 2008; Lewandowski et al., 2006; Pope & Burge, 1996; Rosenman & Friesner, 2004; Schmacker & McKay, 2008; Szczepura et al., 1993; Zavras et al., 2002) versus the use of the number of hours worked (Ferreira et al., 2013; Thurston & Libby, 2002). These methods of determining labour inputs apply to physicians (the main input) and also to other staff (other clinical providers and administrative staff). The inclusion of the hours worked (versus FTE counts) is more precise, since there may be variability in what is considered an FTE across providers. Inputs could also be simplified into operating costs, which can include remuneration of physicians and other employees (Giuffrida & Gravelle, 2001; Luoma et al., 1998; Milliken et al., 2011). There are limitations to the use of costs in terms of difficulties about correctly estimating the costs when practices provide other services and about ensuring that the costs included are related to the delivery of the same services across production units (Milliken et al., 2011).

4.1.3 Factors Affecting Efficiency

Although there are commonalities in the delivery of primary care services, there are also important differences that could affect the efficiency of physicians. In the literature, various other variables, in addition to inputs, were included in the production functions. Some variables were included to identify their effect on efficiency; other variables were included to adjust for externalities that could affect physicians' efficiency.

There is an interest in understanding the characteristics of the structure and organization of primary care practices that are associated with higher efficiency. Such factors can include the size of a practice, the staffing mix, the location, or the supply of physicians for a given population. There is mixed evidence about some of these factors. Medium-sized practices were found to be associated with higher efficiency than large-size practices or small-size practices (Zavras et al., 2002). However, other researchers found no effects of the size of a practice (Andes et al., 2002; Olsen et al., 2013). Patient characteristics such as age (Cordero et al., 2015; Luoma et al., 1998) or lower health status were associated with lower efficiency, using as the output the number of patients (Bates et al., 1996); the rate of hospitalization for ambulatory care sensitive conditions (Cordero et al., 2015); the number of consultations (Ferreira et al., 2013); a combination of the number of visits per patient, the delivery of preventive, chronic disease management, and health promotion services, and also the score for access, continuity, and comprehensiveness of care (Milliken et al., 2011).

Since policy makers may be interested in fostering high efficiency from physicians, there is an interest in understanding the policies that can be implemented to optimize efficiency. Such policies including payment mechanisms for physicians. It is generally accepted that the way that physicians are paid may affect their productivity, defined as the "the level of output produced for a given level of inputs" (Conrad, 2005), and productivity is related to efficiency. Some have argued that, if all primary care physicians (PCP) were paid through fee-for-service (FFS),

efficiency would increase through the use of the number of consultations, patients seen, and referrals as the outputs (Sørensen, & Grytten, 2003). FFS is a method of payment that provides incentives to physicians to produce more services. To increase the production of services, physicians can choose to work longer hours or to shorten the duration of consultations (Guy & Richardson, 2012) through, for example, a "one problem per visit" policy (Fullerton, 2008). Given that FFS physicians are remunerated for each service, it may be more profitable for them to have shorter visits, a practice that allows them to increase the number of visits.

An approach to addressing the constraints on physicians' time for patient care is the substitution by other clinicians for some of the care and administrative tasks. Findings from studies that do include staff mix suggest that such substitution was not significant (Andes et al., 2002; Olsen et al., 2013). There was also a suggestion that that non-medical staff complemented physicians (Thurston & Libby, 2002) and that they were associated with lower efficiency (Luoma et al., 1998). An explanation for the absence of significant difference in physician efficiency may be that only physician visits are included in the output, while non-physician visits that would have otherwise been provided by physicians were not taken into account.

 Payment mechanisms that reward productivity lead to a concern that the physicians could increase the quantity of services provided at the expense of the quality of care. Very few efficiency studies adjust for quality of care, and a reason may be in the lack of availability of quality of care data. Another difficulty is in identification of indicators that would apply to all primary care physicians, given the diversity in the patient populations served. Studies that did adjust for quality of care used process indicators, including the provision of health promotion and preventive services (Milliken et al., 2011) or the way care for asthma patients was provided in accordance with guidelines, including guidelines regarding the prescription and use of antibiotics (Menachami et al., 2013). In both of these studies, a higher quality of care was associated with lower physician productivity and efficiency. Using patient satisfaction with care as an indicator of quality, Amado & dos Santos (2009) did not find any association between quality and efficiency.

Although there is extensive literature on ways to measure the quality of primary care (at the regional system, or individual provider or physician level), there are limitations to the availability of and use of data regarding quality indicators that may be included in efficiency studies. In addition, the specificity of many indicators of the quality of primary care limits their application to specific populations, such as the percentage of patients with diabetes who had the recommended tests.

Because of concerns about apparent physician shortage (which may be partly related to the distribution of physicians and their concentration in urban centres) and about access to primary care providers, the Ontario government has implemented new models of primary care delivery. The financial incentives among these models differ and could affect physician behaviour. The new models are also defined by organizational and structural characteristics that could affect physician efficiency.

4.1.4   Ontario Primary Care Models

Ontario primary care models can be categorized as: Fee-for-Service (FFS); Family Health Group (FHG); Family Health Network (FHN); Family Health Organization (FHO); Family Health Teams (FHTs); and salaried models. All but the FFS and salaried physicians include incentives to enroll patients by asking patients to sign a document recognizing a formal doctor-patient relationship. In the case of salaried physicians, many practice in a team-based environment where patients are associated with a care team (generally including at least one physician and one nurse).

The FFS model is defined by remuneration of physicians for each service provided, as determined by the schedule of benefits. In the FFS model, there are no requirements for physicians to work with others; many FFS physicians work in solo practices. FHG physicians are also remunerated mostly on a FFS basis, but a FHG has a structure that includes at least three physicians. FHG physicians also have incentives to enroll their patients and have requirements for after-hours care, i.e., that the clinic be opened on evenings and weekend days. The physicians receive payments for the delivery of a list of identified services related to disease prevention and health promotion. In this study, FFS physicians are separated from FHG physicians because of these structural and payment differences.

FHN and FHO physicians work in groups with a minimum of three physicians. The main payment mechanism is a capitation fee that is adjusted for the age and sex of patients. The capitation rate covers a basket of services. Physicians are remunerated through FFS for other services. It is estimated that about 60% of their revenues come from capitation payments (Rosser et al., 2011). They also receive financial incentives for providing specific services (more extensive than services provided in the case of FHG physicians) and for reaching targets on the provision of services to specific populations (these incentives are distinct from the fees listed in the schedule of benefits). FHN and FHO physicians are required to provide after-hours care and a telephone health advisory service (THAS). Differences between the FHN and FHO are mainly in the capitation rates, which are higher in the FHO, since the basket of services included is more comprehensive. FHNs are also generally located in more rural areas. Because of the similarities in the payment, structure, and requirements of the FHN and FHO models, they were grouped together in the present study.

The salaried model includes physicians practicing in a Community Health Centre (CHC), with a Rural-Northern Physician Group Agreement (RNPGA), or in a community-sponsored Family Health Team (c-FHT), which is also referred to as a Blended Salary Model (BSM). Physicians in these models are mainly paid through salary, and most of them work with other types of health care providers.

The FHT is a structural model whereby a group of physicians who are remunerated through a FHN, a FHO, or a BSM (in the case of community-sponsored FHTs - a minority) receives supplemental funding from the Ontario Ministry of Health and Long Term Care (MOHLTC) to hire additional health care providers (such as nurses, social workers, dietitians, and pharmacists) and to create an interdisciplinary team. The choice and mix of providers is meant to reflect the needs of the community served by the FHT.

4.1.5   Effect of Payment Mechanisms and Structural Models

Ontario primary care physicians can choose to work in the traditional FFS model or to join one of the newer models. The objectives of the Ontario primary care reform are improvements in access to and in the quality of primary care for the Ontario population. The characteristics of these newer models may affect the ways physicians work, including their productivity and their efficiency.

The introduction of the blended capitation payments (FHN and FHO) also shifted the incentive that physicians had under a FFS remuneration scheme to provide as many services as possible to the service of as many patients as possible (up to 2,400 patients, and payments are reduced for patients beyond that figure).

The salaried model does not have incentives to maximize the number of patients or the number of visits. It does provide physicians with a stable income regardless of the types and volumes of services provided and of patients seen. This payment system provides incentives to physicians to serve fewer patients. It is also a model that has been associated with a higher quality of care and lower productivity (Milliken et al. 2011; Russell et al., 2009).

The findings from the literature regarding the efficiency of primary care physicians raise questions about the effect of primary care models on physicians' efficiency. Ontario is an interesting context for the study of such relationships, given the diversity of primary care models available. Even though the models are specific to Ontario, their general characteristics, such as payment mechanisms and team work, apply to other jurisdictions.

4.1.6   Research Questions and Hypotheses

This study aims to answer these questions: how does productive efficiency vary across primary care models? What are the factors that affect physicians' efficiency?

The emphasis in this study is on the relationship between primary care models and physician efficiency. FFS physicians constitute the reference group.

Given that physicians have incentives to maximize the volume of distinct patients in some models (blended capitation), to maximize the number of visits in others (FFS), and to minimize both in still other models (salaried), both of these output measures are relevant to an analysis. This study examines each of these two outputs separately.

The theoretical, empirical, and experimental evidence suggests that physicians are sensitive to incentives and are more productive when they have financial incentives to be more productive (Allard et al., 2011; Brosig-Koch et al., 2015; Devlin & Sarma, 2008; Hickson et al., 1987; Lagarde & Blaauw, 2014). With this evidence as a guide, a conclusion might be drawn that physicians paid through FFS would be the most productive, and that physicians paid through any other mechanism would be less productive in terms of the number of visits.

It is challenging to hypothesize about the group effect in relation to solo-FFS and group-FFS because the evidence is not conclusive on this subject. It is also difficult to hypothesize on the effect of the FHT, i.e., where the physician works in an interdisciplinary environment, since the evidence on the relationship between team-based primary care and productivity or efficiency is also limited and not conclusive, and this lack of conclusiveness applies to both output measures.

FFS payment offers physicians the incentive to provide as many services as possible. However, FFS does not include any incentives for physicians to see different patients. FFS physicians can increase their revenue by either increasing the number of patients seen or by increasing the *intensity* of services to a given number of patients (or both).

When the number of distinct patients is used as the output measure, physicians paid through blended capitation (FHN and FHO) should be the most productive, given that they have an incentive to maximize the number of patients on their rosters (up to 2,400), but might be expected to show lower productivity in terms of the number of patient visits, as compared to FFS physicians. However, given that FFS physicians do have an incentive to maximize the number of services, regardless of the number of patients, the differences between physicians paid by blended capitation and those paid through FFS may not be significant.

As noted above, salaried physicians do not have any incentives to maximize the number of patients they see or the visits they provide, and, hence, they are expected to have the lowest level of productivity for both measures.

4.2 Analytical Approach

This is a cross-sectional study assessing the efficiency of Ontario primary care physicians across different primary care models. A stochastic frontier analysis (SFA) approach was chosen over the data envelopment analysis (DEA) approach because the SFA considers the fact that there may be noise that could affect efficiency. Because some factors may not be measurable, this technique is more appropriate for the study than the DEA.

With the SFA method, efficiency is determined in relation to a production frontier, which is itself based on the actual productivity of physicians observed in the study sample (Aigner et al., 1977; Meeusen and van Den Broeck, 1977).

The objective here is not only to estimate physicians' efficiency, but also to determine the relationship between the different primary care models and the productive efficiency of physicians. A traditional approach to this process is to first estimate a stochastic frontier model and then, in a second step, to regress the measures of efficiency on the variables of interest. However, this two-step approach has been found to yield biased estimates, and a one-step approach is preferred (Wang & Schmidt, 2002). Hence the one-step procedure as described by Khumbakar et al. (1991) was used here; in this procedure, both coefficients on explanatory variables and efficiency scores are estimated jointly. The coefficients on the explanatory variables indicate the effect of each of the primary care models (as well as of each of the other variables included) on the level of output.

The SFA approach requires specifying a form of the production function, which is typically a Cobb-Douglas or a more general translog. This study is based on a Cobb-Douglas, which is the most commonly used production function; it saves degrees of freedom, as compared to the translog (Rosko 2008). Both functions were compared with the likelihood ratio test, and the Cobb-Douglas was selected. Each physician's productivity is determined by the quantities of inputs utilized and the volumes of outputs produced. Two distinct production functions were estimated, one for each of the two outputs: the number of patients seen in one year and the

number of visits in one year, assuming a Cobb-Douglas production function. Efficiency scores were then estimated for each physician. Input and output variables were log-transformed such that:

$$\ln y_i = \beta' \ln x_i + v_i - u_i \qquad [1]$$

Where:

$\ln y_i$ is the logarithm of the output (the number of patients seen or the number of visits) by physician i; β' is the vector of the parameters to be estimated; $\ln x_i$ is a vector of the logarithm of the inputs; v_i is statistical noise, which can be positive or negative and is assumed to follow a normal distribution centred at zero; u_i is productive inefficiency. Productive inefficiency is non-negative, and its distribution has to be assumed to have either a half-normal, truncated, or exponential distribution. Likelihood ratio tests were conducted to determine the appropriate distribution, as suggested by Rosko (2008). The two parts of the disturbance, i.e., statistical noise v and productive inefficiency u, should be independently distributed.

From [1], the efficiency (E) of physician i can be defined as:

$$E_i = \frac{q_i}{\exp(\mathbf{x}_i'\boldsymbol{\beta} + v_i)} = \frac{\exp(\mathbf{x}_i'\boldsymbol{\beta} + v_i - u_i)}{\exp(\mathbf{x}_i'\boldsymbol{\beta} + v_i)} = \exp(-u_i) \qquad [2]$$

The E of a physician corresponds to the quantity produced (number of patients seen/visits in one year) divided by the expected quantity of output, with the given inputs and the statistical noise.

In addition to the quantities of inputs, outputs may be affected by patients' case mix. Included in the analysis were the characteristics of the patients served by each physician, i.e., age, sex, and health care needs, which were determined with a measure developed by The John Hopkins University called the Adjusted Clinical Grouping (ACG®) weight.

The statistical models also adjusted for the duration of the consultation, as reported by the physicians, with three variables: the average duration of a regular consultation, the average duration of a long consultation, and the percentage of long consultations.

Statistical analyses were conducted with STATA© version 13 at the Institute for Clinical Evaluative Sciences (ICES).

4.2.1   Sample and Data

The sample for the study included all respondents to the Quality and Costs of Primary Care (QUALICOPC) study in Ontario. Only data from the participating physicians were used, including only their own patients (and not patients from other physicians in the practice). Data were collected between January and July 2013. QUALICOPC is an international study that included 34 countries and was led by the Netherlands Institute for Health Services Research (NIVEL). In each country, the same set of four surveys was used to collect data about practice characteristics, physician perceptions of care, patient perceptions of care, and patient values, with only minor changes to accommodate the specific realities of the local health care system (Laberge et al., 2014; Schäfer et al., 2011). Recruitment was conducted in collaboration with the Ontario College of Family Physicians, and interested physicians were sent a survey package (n=229). Of those, 183 physicians completed and returned the survey package. Only one physician per practice was eligible to participate in order to maximize the number of practices involved. There was a CAD200 incentive for participants to cover costs of disruption to the

practice. The sample included physicians in FFS and CCM practices (17), in FHG practices (40), in FHN/FHO practices (54) and in salaried models, including RNPGA, BSM and CHCs (11). A total of 56 of the practices were FHTs. These groups were treated as mutually exclusive, and so the FHN/FHO group excluded physicians working in FHTs.

Data for this study included elements of the Practice and Physician Surveys from QUALICOPC linked with health administrative databases, and also census data held at the ICES at the University of Toronto. QUALICOPC participants were asked to provide their OHIP billing numbers, which were used to link to patient visits in the OHIP database. Based on the physician's billing number, a dataset at the patient level was built, using each patient's own ICES Key Number (IKN) both to link variables on patient characteristics and health care utilization and to construct health status measures for each patient seen by the responding physician. From this dataset, which included both individual patient characteristics and the billing number of the participating physician, a physician level dataset was constructed with the numbers of distinct patients seen, the number of visits, and averages of patient characteristics. This dataset was then merged with the survey dataset that contained variables on each physician's characteristics.

All visits for Ontario residents to the 183 physicians for the fiscal year 2012/13 were included in the study as long as the visits were captured in the Ontario Health Insurance Plan (OHIP) database. A small proportion of Ontario residents do not have medical insurance (such as people with no legal status in Canada), and such visits could not be included because the data were not available.

This study received approval from the Research Ethics Board of the University of Toronto.

4.2.2   Measures

The data for this study were collected from the QUALICOPC study and from administrative databases including the Ontario Health Insurance Plan (OHIP) database, the Corporate Provider Database (CPDB), and hospital databases, including the Discharge Abstract Database (DAD) and the National Ambulatory Care Reporting System (NACRS).

Two output variables were used, i.e., the number of patients seen by each physician in a 12 month period and the number of visits to a physician in a 12 month period. Visit data were taken from the OHIP database. The number of patients seen was calculated by counting the number of different patient health insurance numbers within the visits for each physician.

The input variables included: dummies for each primary care model using the FFS as the reference, the number of hours that the physician reported spending on direct patient care in a week, the number of FTE physicians in the practice, the number of FTE nurses, the number of FTE medical secretaries, the number of FTE managers, and the number of FTE other health providers (assistants for laboratory work, midwives, physiotherapists, dentists, pharmacists, social workers). Inputs also included the number of consultation rooms, which was considered as a proxy for the resources available in terms of space.

The physician practice model was taken from physicians' responses in the survey. Groupings of primary care models, i.e., FFS with CCM, FHNs and FHOs, and CHCs with RNPGA, were based on the similarity between these models (FFS payment and solo practice for the first, blended capitation for the second, and mostly salary and team-based practice for the third). Groupings were necessary to ensure a minimum number of five practices in each category in order to meet the data confidentiality requirements of the ICES.

In addition, the statistical models adjusted for the average duration of a regular consultation, the average duration of a long consultation, and the percentage of consultations that were long, as recorded in the QUALCOPC physician survey. The Rurality Index of Ontario (RIO) was used to control for the geographical location of the primary care physician's practice, since the location may affect access to primary care and to health care services, including hospitals. The RIO is included in the Corporate Provider Database (CPDB) and is a continuous variable that takes a value between 0 and 100, with lower values indicating an urban location and higher values indicating rural and remote locations. The RIO is a measure that was developed by the Ontario Medical Association for Ontario communities (Kralj, 2009). It includes the following 10 variables: travel time to the nearest basic referral centre, travel time to the nearest advanced referral centre, community population, the number of active GPs, the population-to-GP ratio, the presence of a hospital, the availability of ambulance services, social indicators, weather conditions, and selected services.

Variables to control for patient case mix were calculated at the physician level and included the percentage of patients who were women, the average age of patients, the average income quintile of the neighbourhoods that the patients were from derived from their postal code in the census database, and the average Adjusted Clinical Grouping (ACG®) concurrent weight 65+. The patient ACG® weight is a continuous variable that "measures the morbidity burden of patient populations based on disease patterns, age and gender" (The John Hopkins University, 1997). The algorithm takes into consideration the effect of "combinations of types of disorders" (Starfield et al., 1991) based on a reference population 65 years of age and older. An ACG® weight was calculated for each patient who had at least one visit with a participating physician. The calculation was based on the health care utilization data of the patient recorded in billings and in the hospital inpatient (Discharge Abstract Database [DAD]) and outpatient (National Ambulatory Care Reporting System [NACRS]) databases, in the 12 month period ending at the end of the data collection (June 30, 2013).

4.3 Results

Table 4.1 shows the descriptive statistics for the sample overall and for the primary care models. Out of the 183 primary care physicians participating in the survey, nine did not seem to have patient utilization data in the administrative databases and hence could not be included in the study. One physician had six patients seen and eight visits. These extremely low numbers suggest a problem with the data, and the physician was also excluded from the analyses. The majority of the physicians excluded were from CHCs. CHC physicians do not directly bill OHIP. CHCs are required to submit data on physician visits to the MOHLTC, but the data are in a database distinct from OHIP, and this separation explains the missing data for CHC physicians. In addition, participants did not always answer all the questions in the survey, and the result was missing data for some of the variables. The number of observations for which data were available is indicated for each variable and model in Table 4.1. The model specification for the stochastic frontier analysis was adjusted by removing variables with substantial missing data, and the final model included 165 physicians. The characteristics of the physicians excluded are also in Table 4.1, and their distribution over the primary care models is shown in Table 4.2.

The results show that the average numbers of visits and of patients seen per physician varied widely across models, from 3,216 visits and 1,007 patients seen for physicians in salaried models to 6,581 visits and 2,321 patients seen for physicians in group-FFS. The number of hours worked, as reported by physicians in solo-FFS, was the highest, at 44.6 hours, and the number of hours worked was the lowest amongst blended capitation physicians, at 37.7 hours per week. The number of hours spent on direct patient care was also lowest in blended capitation models (30.2). Salaried models also had the longest physician consultation time both for regular (21.8 min.) and long (41.5 min.) consultations. In terms of patient characteristics, the average ACG® weight was the highest amongst patients in salaried models (1.119) and the lowest amongst FHG patients (0.738). Salaried physicians also had older patients on average (an average age of 49.6), the smallest proportion of patients in the highest income quintile (7.8%), and the highest

proportion in the lowest income quintile (28.9%). In comparison, 16.3% and 24.5% of blended capitation (FHN/FHO) patients were in the lowest and highest income quintiles, respectively.

Data were incomplete on some variables. Utilization data (patient visits) were available only for 174 physicians from the 183 participating in the survey; FTE counts of nurses and other providers were each available only for 151 observations. When the variables for the FTE counts of the different providers and staff were included, the number of observations was reduced to 112.

Table 4.1 Descriptive Statistics for the Sample and by Primary Care Model

Variable Name	n	All Mean (sd)	n	FFS Mean (sd)	n	FHG Mean (sd)	n	FHN/FHO not FHT Mean (sd)	n	Salaried Mean (sd)	n	FHT Mean (sd)	n	Excluded physicians Mean (sd)
Dependent Variables														
# of patients seen	174	1,736 (1,118)	17	1,580 (1,292)	40	2,321 (1,741)	54	1,586 (752)	6	1,007 (569)	56	1,564 (646)	9	1,873 (1,499)
# of physician visits	174	5,105 (2,845)	17	5,709 (3,768)	40	6,581 (3,783)	54	4,778 (2,155)	6	3,216 (2,327)	56	4,340 (1939)	9	5,593 (3,707)
Estimated panel[2]	178	1,636 (1,385)	21	1,914 (1,501)	40	1,899 (1,311)	53	1,371 (617)	10	929 (281)	54	1,762 (1912)	16	2,101 (3,495)
Inputs														
Weekly hours	181	40.4 (11.3)	22	44.6 (12.8)	40	42.4 (12.7)	54	37.7 (9.0)	9	38.3 (5.3)	54	38.9 (11.2)	18	38.1 (14.0)
Hours of direct care	181	32.5 (10.6)	22	35.4 (8.8)	40	32.9 (12.9)	53	30.2 (10.0)	10	32.7 (5.4)	55	32.3 (9.7)	16	33.2 (12.1)
Average regular consult duration	183	14.7 (4.9)	22	16.4 (7.0)	40	13.5 (4.8)	54	13.4 (3.7)	10	21.8 (6.2)	56	14.4 (3.6)	18	18.2 (7.1)
Average long consult duration	182	31.3 (9.4)	22	34.9 (12.7)	39	28.8 (9.3)	54	29.6 (7.8)	10	41.5 (11.1)	56	31.0 (8.3)	16	34.6 (14.6)
Percentage of long consult	181	18.0 (10.9)	21	16.0 (12.1)	39	20.5 (11.9)	54	16.9 (8.3)	10	19.0 (18.8)	53	18.2 (9.8)	13	17.8 (14.0)
FTE physicians	164	4.9 (5.1)	21	3.8 (4.8)	31	5.2 (8.8)	50	4.2 (2.9)	9	4.4 (1.6)	52	6.5 (4.5)	16	6.3 (12.1)

[2] The estimated panel was self-reported by physicians in the QUALICOPC survey. The correlation with the number of patients seen and the number of visits indicated was examined and showed low correlation (0.41). A separate SFA was conducted using the estimated panel to test as the output, and the results were consistent.

	N		N		N		N		N		N		N	
Other FTE	151	1.6 (1.8)	16	1.3 (1.6)	32	1.0 (1.4)	46	1.3 (1.8)	10	2.2 (1.4)	45	2.7 (2.0)	16	2.2 (1.8)
FTE Nurses	151	2.5 (2.8)	15	2.1 (3.1)	34	0.6 (1.2)	45	2.0 (2.6)	10	5.7 (3.0)	46	4.4 (3.0)	15	4.2 (3.8)
FTE Med Secretary	175	3.3 (2.8)	20	1.9 (1.6)	38	2.7 (1.9)	52	3.3 (3.3)	10	3.9 (1.9)	55	4.6 (3.9)	16	3.3 (1.8)
FTE manager	164	0.7 (0.6)	16	0.8 (0.4)	35	0.5 (0.5)	50	0.5 (0.5)	10	1.4 (0.5)	53	0.8 (0.5)	15	0.7 (0.7)
Practice RIO	171	13.4 (21.0)	14	22.0 (28.6)	39	6.4 (17.7)	52	9.6 (13.9)	10	34.4 (35.5)	54	16.1 (22.0)	13	16.7 (28.1)
# of consult rooms	183	21.1 (10.2)	22	19.2 (9.8)	40	22.2 (9.9)	54	22.8 (9.7)	10	24.1 (10.8)	56	18.9 (10.6)	18	20.9 (9.0)
Patient characteristics														
Average ACG® weight	174	0.795 (0.252)	17	0.898 (0.377)	40	0.738 (0.174)	54	0.802 (0.214)	6	1.119 (0.759)	56	0.766 (0.156)	9	0.834 (0.201)
% patients female	174	58.9	17	55.9	40	59.6	54	59.6	6	55.6	56	58.8	9	59.2
Average patient age	174	42.8 (6.7)	17	45.9 (8.5)	40	39.7 (5.9)	54	43.3 (5.5)	6	49.6 (11.2)	56	43.4 (6.3)	9	43.6 (9.8)
Average income quintile[3]	174	3.1 (0.5)	17	3.0 (0.5)	40	3.0 (0.5)	54	3.2 (0.4)	6	2.5 (0.6)	56	3.1 (0.5)	9	3.2 (0.5)
Percent IQ 1	174	17.6	17	20.7	40	19.2	54	16.3	6	28.9	56	18.2	9	13.9
Percent IQ 2	174	18.8	17	18.5	40	19.0	54	17.8	6	26.4	56	18.5	9	24.1
Percent IQ 3	174	19.0	17	18.4	40	20.2	54	18.9	6	14.6	56	19.1	9	16.6
Percent IQ 4	174	22.1	17	21.2	40	22.3	54	22.2	6	20.1	56	21.6	9	19.8
Percent IQ 5	174	22.1	17	19.6	40	19.1	54	24.5	6	7.8	56	22.1	9	25.6

[3] Various ways of adjusting for the socio-economic status of patients were tested. The results were consistent across specifications, and the average income quintile was selected to limit the number of explanatory variables. The distribution is reported in this descriptive table in order to provide more specific information about the characteristics of the patients in each model.

Given the large loss in the number of observations due to missing data, a decision was made to remove the FTE counts from the analyses and to conduct sensitivity analyses to examine the importance of these observations. In addition, some of these staffing characteristics were largely correlated within themselves (FTE counts of physicians, nurses, medical secretaries, managers, and other providers), and between the FTE counts and the FHT primary care model, particularly for the number of nurses.

Table 4.2 Distribution of Excluded Physicians (Due to Missing Data) across Models

	n
FFS/CCM physicians	3
FHG physicians	2
FHN/FHO physicians	4
Salaried physicians	5
FHT physicians	4
Total	18

4.3.1   Efficiency Scores

Mean efficiency scores for the all physicians and according to primary care model are reported in Table 4.3. The average efficiency score was 0.722 when using the number of visits as the output and 0.724 when using the number of patients seen as the output. On average, primary care physicians are operating at about 72% efficiency for each output measure, with a wide variation in the scores from 5% to 94%.

FFS physicians consistently had the lowest mean efficiency scores in terms of both output measures (average of 0.632 for visits and 0.611 for patients seen). FHT physicians had the highest average efficiency score when the number of visits was the output (0.740), and FHN

physicians had the highest mean efficiency score when the output was the number of patients seen (0.752).

Table 4.3 Efficiency Scores Using an Exponential Distribution

Variable Name	Efficiency- visits		Efficiency- patients seen	
	Mean Efficiency (sd)	min-max	Mean Efficiency (sd)	min-max
All (165)	0.722 (0.182)	0.062 - 0.936	0.724 (0.168)	0.046- 0.932
FFS (16)	0.632 (0.308)	0.037 - 0.887	0.611 (0.282)	0.054 - 0.893
FHG (38)	0.736 (0.162)	0.254 - 0.936	0.707 (0.162)	0.340 - 0.921
FHN/FHO (53)	0.738 (0.124)	0.564 - 0.917	0.752 (0.153)	0.387 - 0.936
Salaried (6)	0.647 (0.326)	0.062 - 0.873	0.674 (0.314)	0.046 - 0.873
FHT (52)	0.740 (0.163)	0.040 - 0.909	0.738 (0.155)	0.126 – 0.912

4.3.2   Factors Affecting Efficiency

Table 4.4 reports the results from the SFA, using the number of visits in the first column and the number of patients seen in the second column. The final model specification included 165 practices. Analyses were run with other model specifications that included more variables, and the results were consistent.

Because the choice of the distribution of the error term can be arbitrary, each of the three common distributions, i.e., half-normal (which is the default), exponential, and truncated was run. They were tested with the likelihood-ratio test to select the distribution with the better fit,

and the exponential distribution was selected. There were convergence issues with the truncated distribution.

Results from use of the half-normal and the exponential distribution were very similar. The correlation of the efficiency scores from the half-normal and the exponential distributions was over 0.93, suggesting no important effect from choosing either of these two distributions.

The first analyses used the number of visits as the output. In this model, the coefficients on the primary care model variables show that the number of visits is significantly lower for physicians in blended capitation models and interdisciplinary teams (23% and 26% respectively), as compared to FFS physicians, controlling for patient characteristics and location. The other variables that were significantly associated with lower productivity were: the longer mean duration of a regular consultation and the proportion of long consultations, a higher average income quintile of the patient population, and a higher percentage of females in the physician's patient population. The average duration of a long consultation was not significant.

Table 4.4 SFA Results with an Exponential Distribution

Variable Name/Output	Number of Visits	Number of Patients Seen
N=166		
FFS - reference		
FHG	-0.054	-0.053
FHN/FHO	-0.228**	-0.191*
Salaried Models	-0.310	-0.372*
FHT	-0.255***	-0.084
Rural	-0.133	-0.066
Ln(hours spent on direct care)	0.213***	0.187**

Patient Characteristics

Ln (average income quintile)	-0.446*	-0.461*
Ln(average age)	0.166	-1.133***
Ln(percent female)	-0.545*	-0.408
Ln(average ACG)	0.062	0.151
Consult Time		
Ln(Percent long consult)	-0.246***	-0.214***
Ln (long consult time)	0.003	-0.360*
Ln(regular consult time)	-0.852***	-0.377*

Significant at: ***<0.001; **<0.01; *<0.05

Similar results were found when using the number of patients seen as the output. In this case, blended capitation (FHN/FHO) and salaried physicians had a lower output, and the physicians from the other models, i.e., FHG and FHT, had outputs that were not significantly different from those of FFS physicians. In addition to the longer duration of a regular consultation and of a long consultation, a higher percentage of long consultations was also associated with a lower level of output. The number of patients seen decreased with a higher average age of patients and with a higher average income quintile of patients.

It should be noted that an outlier was identified and removed from the analyses. One of the physicians in the salaried model had only seen six patients and had eight visits. Including this outlier in the analyses affected the results and led to an appearance that salaried physicians were less productive. The mean efficiency scores were also lower for both outputs.

Physicians were also asked in the survey for an estimated size of their practice population. There was a low correlation between the estimated panel that physicians indicated and either of the output measures used, based on administrative databases (0.41).

4.4   Discussion

4.4.1   Productivity and Primary Care Models

Productivity, as measured with the unadjusted number of visits and patients seen, was higher amongst FFS and FHG physicians (Table 4.1). Given that physicians in these models are remunerated for each service provided, they have an incentive to have higher volumes in order to generate higher income. Hence, these results are consistent with the theoretical and empirical literature on physician remuneration and productivity.

Although the literature is not conclusive on the effect of the sizes of primary care practices, it is notable that productivity is higher in the FHG than in the FFS physician group. However, it cannot be concluded that the group environment makes the FHG physicians more productive, because it cannot be assumed that FFS physicians are working in solo practices. There is literature that suggests that a group environment would be less productive. Newhouse (1973) proposed that there would be "behavioral diseconomies of scale," and that people may be working less when they are in larger groups. A group environment may also entice physicians to work in a different way, including, for example, with longer visits and discussion of cases amongst themselves.

The results regarding the hours worked by physicians are aligned with evidence that FFS physicians work longer hours (Sørensen & Grytten, 2003), with more time dedicated to direct patient care. Physicians in all other models reported working fewer hours than physicians in the FFS group.

A lower level of productivity among FHO physicians, as compared to FFS physicians, has been previously reported in an Ontario study (Kralj & Kantarevic, 2013). These authors mention that physicians in both models work the same number of days per year, but they do not take into account the number of hours worked per week, which, as the results show, are on average lower for FHN/FHO physicians. The difference in the number of hours worked also suggests that physicians may self- select themselves into a model that corresponds to their work-life balance preferences. Physicians who tend to work longer hours may prefer a FFS type of practice.

4.4.2   Efficiency and Primary Care Models

The results show that that productive efficiency varies greatly among the sample of primary care physicians. Although the unadjusted numbers of patients seen and visits were the highest amongst the FFS and enhanced-FFS physicians, and the other primary care models were associated with lower levels of outputs, these differences are reversed when adjusting for other factors affecting the outputs produced, i.e., patients characteristics and consultation durations. The efficiency scores were actually the lowest amongst FFS physicians in relation to these other factors.

These results are different from those of a previous study of Ontario physicians (Milliken et al., 2011), and a few differences in the methodology may explain the differences in the results. Milliken et al. used the outputs provided by the physicians themselves rather than outputs from administrative databases. The estimated panel sizes reported by physicians are indicated in Table 4.1. There was a 0.41 correlation between the panel size reported by physicians and the number of visits and a 0.34 correlation with the number of patients seen. Data on utilization that is obtained from administrative databases is more precise and accurate than numbers reported by physicians. In addition, the study by Milliken et al. (2011) relied heavily on self-reported data by physicians, not only for the panel size, but also for patient characteristics and for the indicators selected to adjust for the quality of care. For the physician inputs, Milliken et al. (2011) did not

have the number of hours spent on direct patient care, nor did they have any information on the duration of the visits. These are important limitations that were not present in the current study.

Controlling for hours worked ensures that the outputs are adjusted for the fact that some of the physicians in the sample may have diverse functions and may be providing care only on a part-time basis. Controlling for hours also takes into account the fact that physicians may choose to work fewer hours or may be spending more time on indirect patient care, such as to completing forms for patients (such as those for patients on disability programs). The results are also consistent with those of Conrad et al. (1998), who found no significant relation between payment model and utilization of health care services, after adjusting for patient characteristics.

By using the number of hours spent on direct patient care as the input, the model here also controls for what Gaynor & Pauly (1990) termed "effort". In the model that Gaynor & Pauly suggested and that was empirically tested, financial incentives increased the productivity of physicians in terms of the number of services provided, but the effect was achieved through physicians' greater effort (i.e., working longer hours). The financial incentives did not affect the efficiency of physicians, when adjusting for effort.

The mean efficiency scores are remarkably consistent across primary care models for both output measures. Blended capitation (FHN/FHO) and interdisciplinary team physicians have the highest mean efficiency scores, and FFS physicians have the lowest mean efficiency scores. In addition, the mean efficiency scores for each primary care model are quite consistent for the two outputs, with little variation. FFS and FHG physicians, who are remunerated based on the volumes of services, were expected to have higher mean efficiency scores when the output was the number of visits, yet they have lower efficiency scores. These lower efficiency scores suggest that the remuneration method may provide incentives for higher levels of outputs, but, when adjusting for other factors, such as the duration of the consultations and the characteristics of the patient populations, the higher outputs do not mean higher efficiency.

In fact, it appears that FFS physicians produce higher levels of outputs by providing shorter visits and by working more hours; they had the highest number of hours spent on direct patient care, as shown in Table 4.1.

The duration of the patient consultations is an important element. Although length of consultation is not a direct measure of quality, the evidence suggests an association between long consultations in primary care and better quality of care. Research findings indicate that there is less time for questions and for assessment of patients in shorter visits and that consultations of shorter duration were associated with lower satisfaction with the care provided (Gross et al., 1998; Halfon et al., 2011) and with lower patient participation in decision making (Labrie & Schultz, 2015). Longer visits were associated with higher provision of preventive services, higher levels of health education, and higher likelihood of screening (Camasso & Camasso, 1994; Halfon et al., 2011; Morrell et al., 1986; Roland et al., 1986; Wilson et al., 1992). Such health promotion and preventive services may be of growing importance, given the increasing complexity of the conditions of patients presenting to primary care doctors. Patients require more time with a physician because they have multiple health care issues that need to be addressed. Abbo et al. (2008) found that, despite an increase in consultation duration in the US, the number of health care issues addressed within a consultation outpaced the increase in duration, such that the average time per issue addressed declined.

 Although conducting the analyses with the inclusion of FTE counts for other provider types reduced the sample size, the analyses showed similar results. In examinations of the correlation amongst variables, it was noted that there was a high correlation between the FTE counts of other providers and staff, on one hand, and specific primary care models, on the other hand. This correlation suggests that the primary care model variables are to some extent reflective of the number of other providers in the practice. Because the labour input utilized was the number of hours spent on direct patient care and not the total number of hours that physicians worked, the

assumption can be made that the presence of administrative staff would have a limited effect on physicians' outputs, given that their input, i.e, direct patient care, does not include any time that administrative staff could substitute for physicians. In terms of the other health care providers (such as nurses), not including them in the inputs should not affect the outputs selected, since these outputs are physician-based. Non-physician staff may be providing visits to patients, and these visits might increase the productivity measured at the clinic level, but not the physician's productivity.

4.4.3   Patient Characteristics and Selection Bias

Recent research in Ontario suggests that there is a self-selection of physicians into the different primary care models (Rudoler et al., 2015). The purpose of the study was not to examine such selection of physicians into the different models. However, it is possible there are unobservable characteristics of physicians that make them choose to practice in one model, as opposed to another. These characteristics of the physicians could potentially affect the efficiency scores. The descriptive statistics regarding the patients' characteristics raises the possibility of selection bias. Some researchers have found that the effect of selection bias fades over time, and they partly attributed this phenomenon to change in preferences over time (Sørensen & Grytten, 2003). Future research could examine physicians' efficiency over time, for both physicians who stay in the same model and for physicians who switch models. The research would require allocation of enough time to ensure that the physicians are established in each specific practice model to which they belong. Most of the primary care models in Ontario are fairly new, and physicians can still switch from one model to another. It will be interesting to see over time how much mobility there actually will be across models and the long-term effect of mobility on productivity and efficiency. There was a question in the physician survey related to whether the physician was practicing in one of the new models (FHG, FHN, FHO, and FHT) and, if so, for how long. However, given the facts that some models were implemented before others and that some physicians may have shifted more than once, it is impossible to know how the question would be interpreted and, from the answer, to derive the time that physicians have been practicing in their

current particular models. The inclusion of a variable for the duration (in months) that the physician had been in the model was tested and was not significant; this variable on duration did not affect the results as it pertains to the other variables.

To the extent that the analyses examined only associations and not causality, it is not possible to draw a conclusion about the effect of remuneration. However, there is a significant association between lower levels of outputs and higher patient income quintiles for both output measures. This association, which suggests that physicians produce fewer outputs when they serve wealthier populations is unexpected, and raises a question about how physicians may differentiate their treatment in favour of wealthier patients. Various specifications of the models were conducted, with different ways of using the income quintile variable, including the logarithm of the percentage of patients from the lowest/highest neighbourhood income quintiles. The results remained consistent with the association between serving a wealthier population and lower productivity.

A higher percentage of women in a physician's patient population was associated with lower productivity in cases where the number of visits was the output, and productivity decreased as the average age of the patients increased in cases where the output was the number of patients seen. The differences in the characteristics of patients across the primary care models suggest that payment to physicians may not be disentangled from the other characteristics of the way the care is organized and which patients are being targeted. It appears that the payment mechanisms are also aligned with a practice style and specific patient populations. However, an examination of the correlation between models and patient characteristics did not show a particularly high correlation.

In Ontario, the patient populations are different across models, and payment methods may simply be aligned with different objectives (equity of access to care for vulnerable and complex populations in CHCs, versus a higher number of visits in FFS models and of patients seen in

capitation models, for instance). Yet, even when controlling for the patient characteristics that may affect efficiency, salaried models still had a lower level of efficiency in cases where the output was the number of visits. It is not only through their payment systems, but also through their environments that each of these models offers encouragements that may guide the ways physicians behave. Physicians may select to practice in each of these models on the basis of their own preferences. This study did not examine changes in physicians' behaviour over time and in relation to decisions to switch models in a way that would lead to the drawing of a well-founded conclusion about the effect of a primary care model on physicians' behaviour.

4.4.4   Trade-Offs

Efficiency needs to be considered in light of the potential trade-offs, such as between quality of care and efficiency. Quality of care has been found to affect efficiency scores (Murillo-Zamorano & Petraglia 2011). Measuring quality in primary care is quite a complex process, since the choice of measures may actually be quite subjective and limited in relation to data availability.

Efficiency is a characteristic that is largely driven by productivity, which is higher in physicians with shorter visits. Given the association between the duration of consultation and various aspects of the quality of care, such as patient satisfaction, patient engagement, and the delivery of preventive services (Camasso & Camasso, 1994; Gross et al., 1998; Halfon et al., 2011; Labrie & Schultz, 2015; Morrell et al., 1986; Roland et al., 1986; Wilson et al., 1992), variables related to the average time that a physician spends with a patient were used to adjust for the quality of care. However, the implication in the primary care context is that quality of care requires more time (Adams et al., 2001; Chen et al., 2009; Flocke et al., 2002; Lin et al., 2001), and, hence, that better quality is achieved at the expense of productivity. This implication may not always be the case for patients with simple health issues that can be resolved quickly, but it may be particularly relevant in relation to patients with more complex and chronic needs.

Estimation of efficiency in primary care remains a challenge because of the difficulty in identifying and measuring the desired outcomes of the care and also because of the relationship between primary care outputs and outcomes. Policies pushing physicians to conduct more visits as a way to improve access to primary care may result simply in patients having a higher number of visits, some of which may be unnecessary in cases when multiple services and comprehensive care could have been provided during the same visit if it were longer. Policies that provide incentives to physicians to enroll more patients may translate into situations where physicians are not necessarily accessible to those patients when the patients need to see their doctors. Indeed, there is evidence that increased productivity may not benefit patients; Zyzanski et al. (1998) found lower rates of preventive services and lower patient satisfaction in the practices of physicians who had high volumes of patients. In the UK, the National Health System attempted to promote better care by providing additional payments to physicians for achieving targets in the delivery of preventive services. A systematic review of and reflection about the UK experience reveals the mitigation of success, with unintended adverse effects (Doran et al., 2014; Gillam et al., 2012).

The finding that salaried physicians are less productive in terms of number of visits is consistent with the findings of the systematic review of Gosden et al. (2004) and with a previous study, using DEA, on the efficiency of Ontario primary care physicians (Milliken et al., 2011). Although the present study did not measure the kinds of services provided, the longer consultations in the salaried models could suggest that more matters may be addressed in a consultation, either in terms of preventive services, as was found by Kristiansen and Mooney (1993), or in terms of the complexity of the issues at hand (Flocke et al., 2001). However, after adjusting for the duration of the visits, the average efficiency scores of salaried physicians were higher than those of FFS physicians.

Concerns about the efficiency of physicians were raised in a context where increasing the volume of services provided was considered socially desirable (Gabel & Redisch, 1979). From the results, it appears that models with higher levels of outputs (unadjusted) had lower average efficiency scores (adjusted). This finding underlines the importance of adjusting for factors that may affect the levels of outputs that physicians can produce. The average durations of consultations are important to consider since they have not been included in previous studies, even though they have a significant effect on the level of outputs.

4.4.5   Limitations

An important limitation to this study was the sample size, which was reduced to 165 in the empirical analyses because of missing data. This reduction may have resulted in insufficient power to obtain significance on some of the variables in the results. The missing data affected particularly salaried models. Although there were 11 salaried physicians who participated in the QUALICOPC study, only six were included in the analyses, mostly because data about their patients and visits were missing. The small number of salaried physicians (six) not only reflects the fact that very few primary care physicians are remunerated with that method in Ontario (under 1%), but also points to the issue raised by the fact that salaried physicians' billing data is not being submitted to or collected by the Ministry of Health and Long Term Care. Hence, a number of salaried physicians who participated in the survey could not be included because they did not have any patient visits in the administrative databases. The very low outputs of some physicians could be related to such data collection issues. Such an issue is unlikely to affect the FFS physicians since FFS is the mechanism through which they are being paid. Hence, it is in their interest to ensure that the insurer (in this case the Ontario government) is not missing any of their billings.

Although physicians were grouped on the basis of the main payment method, the group of salaried physicians is likely to be quite heterogeneous, since it included physicians working in

community-sponsored FHTs, RNPGAs, and CHCs. RNPGA physicians are required to provide hospital services; the extent of their work in hospitals may largely affect the outputs observed in primary care that are captured here. The variable related to physician input was the number of hours spent on direct patient care, which may have included patient care in other non-primary care settings for some physicians. However, the majority of primary physicians practice in one setting and, in the cases of physicians working in two different primary care practices, their total outputs would have been included. CHC physicians sometimes provide services to people who are not insured and who are absent from administrative databases. These were estimated to represent about 11.5% of the clients served in CHCs (Glazier et al., 2012), which means that the measures of the number of patients seen and of visits do not take into account some visits and some patients seen. The absence of these services from our data would affect the physicians' efficiency scores. According to J. Rayner, this proportion appears to have since increased to about 20% (December 31, 2014, personal communication). Recent changes in federal policy, such as the removal of health care insurance for new immigrants, may partly explain the increase observed. Given that physicians practicing in other models would not receive remuneration from the government, they would be likely to serve fewer patients who do not have insurance.

Although attempts were made to adjust for patient case mix, the measures used remained imperfect. The ACG® weight is amongst the most commonly used measures in primary care and community settings, and it is considered the strongest indicator for health care utilization and costs (Huntley et al., 2012). Yet, the weight was developed to measure patient case mix at a population level rather than at the individual level, and may not fully measure the severity of patients' conditions. In addition, it does not take into consideration individual lifestyles, individual behaviours, and socio-economic status. Socio-economic status may not have been fully captured in the neighbourhood income quintile (health literacy, patient adherence to therapy, immigration status, language barriers, etc.). These patient factors could make the delivery of care more complex for physicians and the process of benefiting from care more complex for patients.

One of the limitations of this study is that, because data on the other physicians in the practice or on other health care professionals delivering health care services were not available, efficiency could be analyzed only at the physician level and not at the practice level, i.e., including all physicians and their total outputs. It is possible that the results would differ if the outputs from other providers could have been included in the model. The evidence about the effect of the number and types of other providers in a practice on efficiency is not clear; some researchers found a positive effect (Rosenman & Friesner, 2004), while, in other cases, the effect appeared to be negative (Luoma et al., 1998). Except for the practices in salaried models, the primary care practices should be relatively similar in the sense that the core of their services is limited to primary care. Practices in salaried models may be affiliated with a multi-specialty centre, or may have more services delivered in a group setting and for the community as a whole.

Finally, a limitation may be that the study relies on data reported by physicians who self-selected for the study. There is a risk of bias that is inherent to self-selection. In addition, physicians reported themselves the number of hours spent on direct patient care, the duration of the regular and long consultations, and the percentage of long consultations. The accuracy of the information could not be validated. The information provided by physicians also did not allow the researchers to distinguish and know the actual duration of the visits and the level of heterogeneity for each physician. Physicians may adjust the time they spend with a patient, on the basis of the needs of the patient.

4.5 Conclusion

A significant finding of this study is the importance of adjusting adequately for factors that can affect the levels of outputs produced by physicians and particularly for the duration of consultations. Even when these factors are accounted for, physicians' primary care models were associated with significantly different levels of outputs on both measures, i.e., the number of patients seen and the number of visits provided.

After adjusting for these factors, the mean efficiency scores were lowest in the models that had the highest unadjusted outputs. The factors that do affect the outputs, other than the primary care model, i.e., the mean consultation durations and patient characteristics, did vary across models. These factors may be partially determined by the model of care.

Physicians in the salaried models, in which length of consultations is greater, also serve what appears to be a more vulnerable population that is older, that comes from lower income neighbourhoods, and that is also in poorer health (with higher ACG® weights). It may be that the longer average consultation length reflects the higher needs of this population. More time spent on each visit means that a physician cannot have as many visits as a physician who has shorter visits. Adjusting for the duration should have removed the potential for bias against the non-FFS models in this regard.

The existence or availability of any study that used average consultation time data is unknown. Yet average consultation time appears to be an important factor in the productive efficiency of physicians, a characteristic that is driven by volume. From a policy perspective, it is important to consider that increased physician productivity may be achieved at the expense of the duration of patient visits. Although it was not within the scope of this study to examine the quality of care and patient outcomes, these factors should be considered in any policy that may encourage higher productivity amongst physicians. Physicians with higher productivity appear to be achieving higher productivity by conducting shorter visits. Although shorter visits may be effective in delivering some services, the shorter duration may also affect the quality of the care provided. This possible impact is an important consideration for the most vulnerable and complex patients, who may need longer durations to benefit from the physician visits.

Given the differences across the Ontario models, not only in the physician remuneration mechanisms, but also in the patients that the mechanisms serve (and probably in their organizational cultures, values, and goals, which are not studied here), the process of interpreting

the results of this efficiency analysis is challenging. Efficiency can be considered one aspect of the performance of primary care physicians. The results from this study suggest that the ways physicians are paid and the ways they are organized may affect their productivity. The mean efficiency scores, however, were quite different from the unadjusted levels of outputs produced by physicians across primary care models.

The efficiency scores, with an average of 0.72, can be considered low, as compared to the efficiency found in other sectors in the Canadian health care system. These low efficiency scores raise questions about possible avenues to an increase in the efficiency of physicians in the delivery of primary care. These questions could be investigated in future research.

Chapter 5. Conclusions

5.1 Summary of Study Findings

The aim of this thesis is to examine the performance of the primary care models in Ontario in relation to three dimensions: effectiveness, cost, and efficiency. The primary care models are characterized by different payment mechanisms and practice requirements. Each payment mechanism is a specific combination of FFS, capitation, and performance target-based payments, and these mechanisms have different incentives that may affect physician behaviour and the way that physicians provide care to their patients. The practice requirements are related to the hours that the care is made available and to the size of a practice (either solo or with a minimum of three providers), as well as to the inclusion of other (non-medical) health provider types who offer interdisciplinary team-based care.

The first study examined the effect of belonging to each primary care model on the probability of a patient having an ACSC hospitalization in a one year period (April 1, 2012, to March 31, 2013). The study population included all residents of Ontario eligible for OHIP coverage who had been previously diagnosed with an ACSC. The method used was a logistic regression model, with patients of FFS physicians as the reference group. The results indicated that the risk of an ACSC hospitalization was higher for patients of Family Health Teams (FHTs- i.e. interdisciplinary teams where physicians are remunerated through blended capitation) and lower for enhanced-FFS and blended capitation patients.

The second study examined the incremental costs associated with each primary care model in relation to primary care costs and total health care costs, using FFS physicians as the reference group. The study was based on a 10% sample selected at random from the Ontario adult population eligible for publicly funded health care. Costs were calculated at the patient level, using administrative databases of health care utilization and the costs of services, with a method developed by Wodchis et al. (2013). Analyses were conducted using generalized linear model regressions. Again using the FFS as the reference, patients in enhanced-FFS models were found to have the lowest total health care costs and also the lowest primary care costs; patients in the blended capitation models had lower health care costs, but higher primary care costs, as compared to FFS patients. Higher primary care costs for patients in the blended capitation models, as compared to FFS patients, appear to be offset with lower overall health care costs. Overall, all the new models had lower total health care costs, as compared to the FFS.

The third study examined the productive efficiency of Ontario primary care physicians. The efficiency was based on two output measures of physician productivity, i.e., the number of patients seen and the number of visits provided in a 12 month period. The study linked data from a survey conducted with 183 self-selected Ontario physicians to data contained in administrative databases. The input was the number of hours that physicians reported spending on direct patient care on a weekly basis. Adjustments were made for the duration of the visits, the geographic location of the physician's practice, and the characteristics of the patient population served by each physician. The results showed that some primary care models, namely, blended capitation and salary, were associated with significantly lower levels of outputs. In terms of the efficiency scores, the scores were actually lower in the FFS model and highest in the blended capitation and interdisciplinary team models.

Each study adjusted for characteristics of patients that may affect the outcomes in each of the studies: age, sex, socio-economic status through the neighbourhood income quintile, and health status through the ACG® weight. In all studies, the patients' characteristics did vary from one model to another and significantly affected the outcomes studied. Even adjusting for these

variables, there were still significant differences across primary care models in terms of their effectiveness and the costs of care.

5.2 Contributions

Each of these studies builds on and contributes to the literature in a number of areas, for example, ACSC hospitalizations as an indicator of the quality of primary care, the costs of health care services, and the efficiency measurement of primary care physicians.

The literature on ACSC hospitalization originates from the US (Billings et al., 1993), and local definitions for the indicator were developed in a number of countries, including Canada (Brown et al., 2001; Roos et al., 2005). The literature examining ACSC hospitalizations continues to expand as researchers in more countries around the world examine these hospitalizations in order to measure various dimensions of the quality of primary care.

The ACSC hospitalization indicator has been used mostly at a regional level to study the effect of specific factors, such as a health care reform (McCormick et al., 2015), increased funding for primary care (Milne et al., 2015), or the supply of physicians (Burgdorf & Sundmacher, 2014; Falster et al., 2015), on the ACSC hospitalization rate. A reason that could explain such analytic approaches is the lack of available data and the inability to link patient-level data in the United States, where many studies originate (McCormick et al., 2015). Only recently have researchers used a patient-level approach to examine factors that may affect the risk of a hospitalization, such as insurance status (Arrieta & Garcia-Prado, 2015) or socio-economic status (Trachtenberg et al., 2014). An important contribution of this study, which was conducted using Ontario population data, was the ability to analyze data at the patient level that came from a very large population (over 1.7 million) and from a large and diverse geographical area. For this reason, it

was possible to adequately adjust for patient characteristics through the linkage of data across databases. This research has provided information that relates to the specific aim of the study, which was to determine the relationship between the primary care models and the risk of an ACSC hospitalization. The study also contributed to the evidence regarding the importance of patient characteristics on the risk of an ACSC hospitalization. In particular, the study indicated the significance of socio-economic status, a significance that has also been found in other jurisdictions with universal health coverage (Gusmano et al., 2014).

Although the focus of the thesis is on the primary care models, it also contributes to the literature on disparities, such as poorer health outcomes for individuals from lower income neighbourhoods. These disparities were also found in the study on costs; the finding was that costs decreased for patients in the neighborhoods in higher income quintiles. The study on costs of health care contributes to the literature on the association between strong primary care systems and high-performing health care systems (Starfield et al., 2005). Total health care costs were lower for patients in the new primary care models (between $392 patients that were in FHT-funded FHOs and $667 for patients of FHGs) than they were for patients in the FFS model, adjusting for patient characteristics. The exception was the cost for patients who saw a physician in a new model, but were not enrolled with the physician. Their primary care costs were not significantly different from those of patients seeing FFS physicians, but their total health care costs were higher by $130. This finding raises concerns about the quality of care that is received by non-enrolled patients of physicians in patient enrolment models; these patients appear to utilize more expensive services. It is interesting to observe that the highest gains, in terms of reductions in patient costs and particularly reductions of total health care costs, are found in patients enrolled with physicians in enhanced-FFS models. One of the main characteristics of the enhanced-FFS model, as compared to the FFS, is that there is a comprehensive care capitation for enrolled patients. The FHG physicians also receive a comprehensive care premium and additional payments for a defined list of services to enrolled patients. These additional payments may incentivize physicians in the provision of more comprehensive care to their enrolled patients; the result may be better health outcomes, as compared to FFS patients.

The unit of analysis for the efficiency study was the primary care physician (as opposed to the patient, the unit of analysis in the other two studies). However, the efficiency study did build from a patient-level dataset to determine the characteristics of the patient populations served by each physician. The study examined the effect of the primary care models on the productive efficiency of the physicians, using a stochastic frontier analysis (SFA) method. The majority of efficiency analyses in the health care field use the Data Envelopment Analysis (DEA) method, and although SFA is receiving increasing interest and is being used in more recent studies, the number of studies of physician efficiency that use SFA remains limited (Heimeshoff et al., 2013). In addition, efficiency studies have been limited in their capacity to adjust for patient case mix, a shortcoming that was addressed here with patient-level data on age, sex, ACG® weight, and neighbourhood income quintile, which was then aggregated to the physician level. The issue of efficiency has also been considered in relation to the quality of care either in terms of trade-offs (Martini et al., 2014) or in terms of the way to adjust for quality (Cordero Ferrera et al., 2014; Milliken et al., 2011). Quality is a complex concept that is particularly challenging to measure in primary care. Although the study here did not include any measure of the quality of care or of patient outcomes, it did include variables on the average duration of regular and of long consultations. Although longer consultations cannot be interpreted as necessarily of higher quality than briefer ones, there is evidence associating better quality of care (in various dimensions) with longer consultations (Camasso & Camasso, 1994; Gross et al., 1998; Halfon et al., 2011; Labrie & Schultz, 2015; Morrell et al., 1986; Roland et al., 1986; Wilson et al., 1992). After adjusting for explanatory factors, the average efficiency scores were higher in the blended capitation and interdisciplinary team models and lower in the FFS model.

5.3 Policy Implications

The findings of the three studies have implications for policy makers in Ontario and in other jurisdictions.

The Ontario government implemented the primary care reform with increasing both access to care and the quality of primary care for the population. Overall, the results from the studies suggest that all the models of care implemented perform better in relation to the dimensions measured than the traditional FFS model, which almost all primary care physicians were practicing prior to the reform.

In relation to the population with ACSCs, the models introduced appear to be more effective at preventing an ACSC hospitalization, with the exception of the FHT. The findings also indicate that the patient characteristics are important factors in all the outcomes examined. However, even when adjusting for patient characteristics, there are remaining differences amongst models.

The results also show that the interdisciplinary FHTs serve healthier and wealthier patient populations, to an even greater degree than their blended-capitation non-FHT counterparts (FHNs, FHOs). In these non-FHT counterparts, physicians have the same remuneration plans and practice access requirements, but are not funded to employ an interdisciplinary team. The fact that FHTs serve healthier patients may indicate a partial failure of the FHT model, in the sense that it was originally designed and intended for a more vulnerable population that would need the comprehensiveness of the services offered by FHTs and might benefit the most from the services. Indeed, the FHTs include a diversity of provider types under a single roof and offer various services in an individual or group environment to patients with chronic conditions in order to help them manage their health. Despite the additional resources put into these organizations for the provision of such comprehensive care, the outcomes achieved appear to be lower than the outcomes in the non-FHT practices. However, the purpose here is not to conclude that FHTs are not a good model of delivering primary care, but instead to suggest that these organizations may not be serving the patient population that may benefit most from this primary care model. Such a finding may be a reflection of the absence of incentives for FHT physicians to serve a more complex population. In fact, the blended capitation payments to FHT physicians

would actually provide incentives for the selection of a healthier population, given that the payments are only age and sex adjusted. It may be necessary to revisit the requirements for physicians in terms of the patient population served.

The reform's aim, which was to improve access to primary care for all Ontarians, appears to have not been achieved in terms of prioritizing equity of access, and facilitating access to interdisciplinary teams for those in need of more comprehensive primary care services. The median ACG® weight of the FFS patients suggests that there are a number of patients with higher morbidity in that group; this is an expected finding, given that FFS physicians can bill for each service provided to such patients.

The majority of the population may benefit from having a regular source of primary care, and continuity is particularly important to the most vulnerable populations (Nutting et al., 2003). However, it is understandable that a small proportion of the Ontario population may not want a regular primary care provider. This is particularly the case for young men who are healthy, and likely explains the lower average age of the FFS patients. However, there are no incentives in any of the models to provide continuity of care to the most vulnerable and complex patients, and some of these patients may have higher health care costs and worse outcomes because they do not have a regular source of care.

An alternative to the development of diverse models that suit the practice style and preferences of physicians is the design of models for specific patient populations, such that the payments and the delivery models are aligned with the needs of the population being served. The descriptive results do show consistently across all three studies that physicians serve different population groups across models. These differences point to the need to adjust physician compensation in relation to patient complexity and outcomes.

Patients with lower health status are the most vulnerable, and they are at risk of requiring resource-intensive health care. Hence, appropriately compensating primary care physicians to serve these patients in environments, such as interdisciplinary teams, that provide adequate services (including, for example, social workers and dietitians) could potentially improve outcomes and reduce utilization of more costly services in other sectors of health care.

The findings of these studies are valuable for policy makers from other jurisdictions. In Canada, Ontario is considered to be the most advanced province in the reform of primary care and, particularly, in moving physicians away from FFS payment towards blended payment mechanisms. A lesson that can be learned is that there is no current model that perfectly aligns payments with patient outcomes and equity. A primary care model that targets patients with barriers to access, the CHC model, could be included only in the study on physician efficiency. Hospitalization and cost data were not available for the other two studies to include CHCs in the study on ACSC hospitalization and in the study of primary care and total health care costs. One important consideration is that the duration of patient consultation is longer in the CHCs. The longer consultations may be partly explained by a payment model that does not provide incentives for the productivity of physicians, but they also may reflect the greater need on the part of patients who have complex issues.

The case of the CHC is interesting because it is a model that actually aligns the physician payment method with the objectives of the model, i.e., serving patients with barriers to access. Yet, in doing so, CHCs do have lower levels of outputs in terms of patients seen and visits. Staff in CHCs have long asserted that longer visits are required when health care providers see patients who may need an interpreter or have disabilities. It is also a model in which physicians are part of an interdisciplinary team that can offer a diversity of services under one roof.

The expansion and implementation of team-based primary care is a shift that is based on evidence that suggest that there is a better quality of care in such models. The requirements for

after-hours care might have improved access for patients who do have a primary care provider and could potentially have resulted in lower utilization of other services, such as emergency departments, outside of regular hours. However, issues of equity of access appear to remain, and populations with lower socio-economic status consistently appear to have poorer health outcomes.

5.4 Limitations

It is unfortunate that some of the primary care models, such as CHCs and the Nurse Practitioner (NP)-led clinics, could not be included in all the studies, due to the lack of data availability and to their small number. The CHCs were included in the efficiency study, but there were only a few CHC physicians (a fact that also reflects the small number of CHCs in the province), some of whom did not have any billing data. Because of the remuneration method, i.e., salary, CHC physicians do not bill the MOHLTC. It is also possible that the data were incomplete for the CHC physicians who did have data in the OHIP database and that those with information in the database practiced in a non-CHC clinic as well. The billings would be associated with the other practice rather than with the CHC.

NP-led clinics are a new primary care model where the care is delivered almost entirely by NPs. Because the NPs do not bill OHIP, the data on the patients that they see could not be obtained and included in any of the studies. The study protocol for the QUALICOPC study, which was the basis of the efficiency study, was meant for physicians, and recruitment was conducted in collaboration with the Ontario College of Family Physicians. NPs hence did not have an opportunity to participate.

The studies relied on the accurate coding and billing of services by physicians to the MOHLTC. However, there may be differences in the billing, depending on the model that a physician belongs to. Because FFS and enhanced-FFS payment is linked to the services provided, physicians in those payment models are the least likely to omit any billing, since the omission would cause them to not receive a payment for a service provided. Physicians in blended capitation models receive a small percentage (15%) of the amounts in the FFS billing codes for the services included in the capitation payments. Hence, for them, the omission of a billing has a much smaller impact on remuneration. This means that billings for non-FFS physicians may be underestimated because of physicians' omission to bill for each service, particularly for services included in the capitation payments. These differences in billings may not only affect costs estimates, but also the ACG® weight of patients, if not all of a patient's conditions are recorded.

One of the difficulties experienced in conducting each of the studies was in the assignment of patients to a primary care model and the categorization of the models. Because of the aims of each study and the limited number of physicians for the efficiency study, the categorization of primary care models was slightly different from one study to another.

In the effectiveness study, the purpose was to examine the effect of the delivery of care on the risk of an ACSC hospitalization. Because the blended-capitation models (FHNs and FHOs) are similar in their payment structures, requirements, and organization of care, they were grouped together for simplicity. Similarly, patients in enhanced-FFS models (CCM and FHG) were grouped. FHTs were considered a separate model, but included both FHTs funded as FHN and FHTs funded as FHO. Sensitivity analyses were conducted to verify that these groupings did not affect the results. The only notable difference in the results was in the treatment of the non-enrolled patients who saw a physician in a patient enrolment model (CCM, FHG, FHN, or FHO). In the final model, these patients were included in the reference group (as FFS patients). Yet when non-enrolled patients in a patient enrolment model were treated as a separate group, the risk of an ACSC hospitalization for FHN/FHO patients (not FHT) was not different from that of FFS patients, while that of the non-enrolled patients was significantly higher. The coefficients on

the other primary care model variables were consistent. This outcome for non-enrolled patients raises questions about how physicians may treat differently patients not enrolled with them, or how they choose not to enroll patients whom they consider as potentially requiring more care (and hence as more profitable to see on a FFS basis) and more at risk of adverse outcomes (such as hospitalization).

The cost study is the one that had the highest number of primary care models. The reason for not grouping patients together was that the payments to primary care physicians were different in each of these models and, hence, the primary care costs may differ. Because there was an interest in seeing if the FHT model as a delivery model could affect costs (through, for example, reduced utilization of services in other sectors), and if there were cost differences between FHNs and FHOs, these two groups also had to be distinguished for FHT patients into FHT-FHO and FHT-FHN.

In the efficiency study, the CCM physicians were grouped with the traditional FFS group rather than with the FHG. This grouping was done because the literature suggests differences in the efficiency and productivity of physicians in a group setting versus a solo practice. The physicians that still practice in a traditional FFS were assumed to be working in solo practices, and the data from the physicians participating in the QUALICOPC study did suggest that this was the case. Because of the organizational similarities in the staffing mix (i.e., most likely solo practices and no resources or requirements in relation to physicians working in groups or hiring other providers or administrative staff), CCM physicians appeared to be more similar to FFS physicians than to FHG physicians. The efficiency study is the only one that included the salaried models, and the reason for that inclusion is that the number of physicians from the salaried models participating in the QUALICOPC was higher than their proportion in Ontario overall. In the other two studies, which used either all Ontarians with specific conditions or a random sample of the Ontario population, the number of patients from these salaried models was too small, as compared to the overall study population, to be included.

Another limitation in the statistical model is its reliance on the ACG® system to adjust for case-mix. Although this system has been tested and validated in multiple settings, including Ontario, and is considered as the most accurate case-mix adjustment system for primary care, it does not include socio-economic factors and other factors related to patients' capacity to live and manage their conditions, such as a strong social support network of family and friends or a higher level of education. This information is not available in the Ontario databases. In addition, "clinical groupings do not fully account for interactions among types of comorbities (for example, physical and psychiatric morbidities) or for the fact that individual comorbidities may be linked in a causal chain" (Rosen et al., 2003). In order to take into consideration socio-economic factors, the neighbourhood income (based on postal code) was included as one of the variables. Neighbourhood income has been used as a proxy for household income, which is also related to other socio-economic factors.

All three studies used a cross-sectional design, which is a limitation in the sense that the design does not inform the causality of the relationships. The results show associations between the models of primary care and the outcomes examined in each study, but the interpretation of the relationships remains limited.

5.5 Future Research

The results of this research point to further examinations and, more specifically, to examinations of specific population groups. Given the differences observed in patient characteristics across the primary care models, there is a need to better understand the relationship between the primary care model and the delivery of good primary care for patients, including specific types of patients.

Primary care is seen as reducing inequities in health (Starfield et al., 2005), but the model a patient belongs to (or does not belong to in the case of patients who are not enrolled with a physician) is associated with the socio-economic status of a patient. Thus, it is questionable whether the distribution of patients across models by socio-economic status is optimal for patient care.

This research examined performance in relation to the general population, with the exception of the effectiveness study, which focused on the population diagnosed with one of the seven chronic conditions in the ACSC list, as defined by CIHI. Given that about 10% of the Ontario population has one of those conditions, the list was still representative of a broad population. There is a need to look into specific population groups in future research and particularly the vulnerable population with complex needs. Wodchis et al. (2012) found that about a third of the health care expenditure in Ontario was accounted for by 1% of the Ontario population. Payment mechanisms that provide incentives for physicians to deliver care in a way that is optimal to patient outcomes, including the provision of care for patients who are the most at risk of a decline in their health, represent an opportunity to control health care costs and to reduce health disparities.

It may be interesting to look specifically at the other models of primary care that were not included here, such as the NP-led clinics. These clinics could be of interest specifically for members of vulnerable populations, who may benefit from the better communication, self-care, and management found in NPs, as compared to doctors' practices (Horrocks et al., 2002). There is very limited evidence on the performance of these clinics, yet a review of the literature on the care delivered by nurse practitioners does suggest that they do provide care of a quality equivalent to that of physicians, if not better (Horrocks et al., 2002). Studies of specialized nurse-led clinics also support the effectiveness of the care that NPs can provide to populations with specific complex conditions (Denver et al., 2003; Hill et al., 2003; Sarro et al., 2010). There were

only 26 NP-led clinics in Ontario during the study period, and these were established in rural and remote communities where physician recruitment is a challenge. Little is known about them, but they do represent an interesting alternative in a context of a shortage of primary care physicians in these jurisdictions (Kralj & Kantarevic, 2012; Nicholson & Levy, 2009).

Future research could look at the patients who had ACSC hospitalizations and identify the factors that led to these hospitalizations, as compared to similar patients who did not have ACSC hospitalizations. Such research could reveal both the health care needs and the social determinants that may affect the capacity of patients to control their conditions.

Finally, there is a need to rethink efficiency. Efficiency is traditionally defined and was defined here too by the productivity of the physicians. However, this productivity is highly driven by the time that physicians spend in a consultation. In the models where physicians are pressured or have incentives to provide a higher volume of services, they reduce the average time spent with patients, a reduction that is likely to result in multiple visits. Although shorter visits may be appropriate in some circumstances, they may not be appropriate in cases where the patient has multiple complex issues, a difference that makes controlling for the visit length important. The blended-capitation and salary payments have the benefit of not providing incentives for an over-supply of care, and, hence, visits for normal test results or a renewal of a prescription can be avoided. However, blended-capitation and salary models may result in access issues. Measures of efficiency need to be further developed in order to take into account the interaction with other levels of care and in order to better reflect the objectives of health care.

The three studies provided an overview of the performance the Ontario primary care models at the patient and physician levels. The studies identified differences across the models as well as challenges that need to be addressed in primary care in order to improve the delivery of care and patient outcomes.

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Appendices

Appendix 1. Summary Table of Ontario Primary Care Models

Model	FFS	CCM	FHG	CHC	FHN	FHO	FHT
Practice size	Solo or group	solo	3+	Team practice	3+	3+	Group practice
Enrolment	No	Yes	Yes	No (abolished in 2011)	Yes	Yes	Yes
Provider payment type + other payments	FFS	FFS + some incentives: 1, 3, 4, 6, 7, 8, 9, 10,11, 14	FFS + incentives: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	Salary (incentives abolished in 2011)	Blended capitation + incentives: 3, 4, 6,7, 9, 10, 11,12, 13,14, 15, 16,17, 18,19,	Blended capitation + incentives: 3, 4,6,7, 9,10, 11, 12,13,14, 15, 16,17, 18,19	Funded through other models; mainly FHO
Requirements	No	Extended hours, On-call	Extended hours, On-call Telephone Health Advisory Service				
Incentives	Complex Care Premium: 15% premium for A003, C003, W109, A903, W903 and A007 for patients over 70	1. Patient registration incentive 2. Comprehensive Care 3. Comprehensive Care Management Fee 4. After Hours Care 5. Palliative Care 6. Diabetes Management Incentive (Q040) 7. Heart Failure Management Incentive (Q050) 8. Cumulative Preventative Care Management Payment (Bonus): pap smears, mammograms, flu vaccination, childhood vaccination 9. Colorectal Screening Bonus 10. Smoking Cessation Counselling Fee and Smoking Cessation Add-on Fee 11. New Graduate- New Patients Incentives 12. Primary Health Care of Patients with Serious Mental Health Illness 13. New Patient Premium 14. Unattached Patient Fee: $100-$180 depending on age, $350 for complex vulnerable patients 15. Group Management and Leadership Payment 16. Preventative Care Management Service Enhancement Fee (Reminder Fee) 17. Targeted Medical Education 18. Special Payments (Premiums) 19. Newborn Care Episodic Fee					

Appendix 2. List of ICD Codes for Each of the ACSCs

Condition	ICD-9CM	ICD-10-CA
Grand mal status and other epileptic convulsions	345*	G40, G41
COPD	491*, 492*, 494*, 496*	J41, J42, J43, J44, J47
Asthma	493*	J45
Diabetes	250.0*, 250.1**, 250.2**, 250.8*	E10.0, E10.1, E10.63, E10.64, E10.9, E11.0, E11.1, E11.63, E11.64, E11.9, E13.0, E13.1, E13.63, E13.64, E13.9, E14.0, E14.1, E14.63, E14.64, E14.9
Heart failure	428**, 518.4**	I50, J81
Hypertension	401.0**, 401.9**, 402.0*, 402.1*, 402.9	I10.0, I10.1, I11
Angina	411.1, 411.8, 413	I20, I23.82, I24.0, I24.8, I24.9
*Indicates that the code is part of the expanded ACSC list proposed by Caminal et al (2004).		
** Indicates that the code is part of the core ACSC list proposed by Caminal et al (2004).		

This table is adapted from the Technical Note on Ambulatory Care Sensitive Conditions (ACSC) developed by the Canadian Institute for Health Information (CIHI) and from Caminal et al (2004).

Appendix 3. Correlation Matrix for the variables in the study on ACSC hospitalizations

	Age	Income quintile	FFS	FHT	CCM	FHG	FHN	FHO	RIO	ACG®	gender
Age	1.0000										
Income quintile	0.0187	1.0000									
FFS	0.0993	0.0463	1.0000								
FHT	0.0175	0.0122	0.1534	1.0000							
CCM	0.0164	-0.0255	0.0826	-0.0944	1.0000						
FHG	0.0033	-0.0225	0.2940	-0.3358	-0.1228	1.0000					
FHN	0.0062	0.0001	0.0762	0.2598	-0.0318	-0.1133	1.0000				
FHO	0.0629	0.0643	0.4179	0.3710	-0.1746	-0.6210	0.1610	1.0000			
RIO	0.0409	0.0667	0.0667	0.2456	0.0099	-0.2029	0.3388	0.1201	1.0000		
ACG®	0.2491	-0.0303	-0.0143	-0.0223	0.0072	0.0227	-0.0084	-0.0314	-0.059	1.0000	
Gender	0.0387	0.0172	0.0172	0.0058	-0.0012	0.0097	0.0010	0.0039	-0.0079	0.0908	1.0000

Appendix 4. Average ACG weight by income quintile and primary care model for ACSC patient population

	Total	FFS	CCM	FHG	FHN	FHO	FHT
Income quintile 1 ACG®	0.543	0.497	0.579	0.579	0.533	0.541	0.542
Income quintile 2 ACG®	0.517	0.483	0.550	0.553	0.472	0.508	0.497
Income quintile 3 ACG®	0.504	0.461	0.553	0.542	0.487	0.492	0.481
Income quintile 4 ACG®	0.495	0.461	0.529	0.532	0.473	0.482	0.476
Income quintile 5 ACG®	0.487	0.459	0.531	0.524	0.478	0.476	0.463
IQ 1 ACG® - IQ 5 ACG®	0.056	0.038	0.048	0.055	0.055	0.067	0.079