Effects of primary care reform in Quebec on access to primary health care services

Catherine Dunkley-Hickin
Department of Epidemiology, Biostatistics and Occupation Health
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Abstract

Primary health care reform has become an area of priority in health policy with a strong importance placed on interdisciplinary teams of health care professionals. Quebec's model, the *groupes de médicine de famille* (GMFs), were introduced late in 2002 emphasizing team-centered approaches to service delivery and aiming to improve access to primary health care, especially to improve after-hours access and to increase the number of Quebecers with a family doctor.

A decade after their implementation, I investigated the impact of GMFs on various measures of access to primary health care and perceived remaining barriers. I emphasize potential access – i.e. measures that capture whether an individual has the ability to access needed health care including having a regular medical doctor.

I used data from seven waves of the Canadian Community Health Survey to capture reported access to primary care and barriers to access. GMFs emerged at different rates in different health regions across Quebec allowing the construction of a GMF 'participation' measure using the share of primary care physicians practicing in GMFs in each health region and year. I employed a modified difference-in-difference analysis design that uses multivariate regression analysis to control for time trends in the outcomes, time-invariant differences between regions and individual-level covariates in an attempt to estimate the causal impact of GMF implementation on access to primary health care.

I verified that pre-policy differences in terms of population and socioeconomic characteristics between regions with ultimately high vs. low rates of GMF participation are reasonable and remain fixed over time, making comparisons of these regions appropriate. Results suggest that rates of reported access have increased over time in most Quebec health regions. However, these measures of access vary across regions and some always report lower rates of access. Controlling for time trends, fixed differences between regions, and individual characteristics, reported access does not change significantly as GMF participation increases.

Improved access to primary health care was one of the principal objectives of Quebec's primary care reform a decade ago. My findings suggest that increased GMF participation has not improved several important measures of access, and that additional policy measures may be necessary to increase potential access to primary health care.

Abrégé

La réforme des soins de santé de première ligne occupe une place prioritaire parmi les réformes de santé, notamment avec une grande importance accordée à des équipes interdisciplinaires de professionnels de santé. Le modèle choisi par Québec, les groupes de médecine de famille (GMFs), a été mis en place à la fin de 2002. Ce modèle met l'emphase sur des équipes interprofessionnelles et vise à augmenter le nombre de Québécois avec un médecin de famille, ainsi qu'à offrir une plus grande accessibilité des services de la première ligne, notamment hors les heures normales de travail.

Une décennie après leur implantation, j'ai étudié l'impact des GMFs sur diverses mesures d'accès aux soins de santé de première ligne. Je mets l'emphase sur l'accès potentiel – c'est-à-dire les mesures permettant de déterminer si un individu a la possibilité d'accéder aux soins de santé nécessaires, y compris d'avoir un médecin régulier.

J'ai utilisé des données de sept cycles de l'Étude sur la santé dans les collectivités canadiennes pour capturer l'accès déclaré aux soins de première ligne et obstacles à cet accès. Il existe une variation régionale dans l'implantation des GMFs à travers les différentes régions sociosanitaires du Québec, ce qui me permet de construire une mesure de participation aux GMFs constituée de la proportion des médecins de première ligne pratiquant en GMF par région sociosanitaire et par année. J'ai employé une analyse qui consiste de modèles de différence-dans-les-différences modifiées qui utilise une analyse de régression multivariée pour contrôler les tendances temporelles, les différences constantes entre les régions, et les covariables au niveau individuel, le but étant d'estimer l'effet causal de la mise en œuvre des GMFs sur l'accès aux soins de santé de première ligne.

J'ai vérifié que les différences de caractéristiques populationnelles et socio-économiques dans la période pré-politique entre les régions ayant un taux élevé par rapport à celles ayant un faible taux de participation aux GMFs sont raisonnables et fixes au cours des années de mon étude, rendant ainsi toute comparaison de ces régions appropriées. Les résultats suggèrent que les taux d'accès déclarés ont augmenté au fil du temps dans la plupart des régions sociosanitaires du Québec. Toutefois, ces mesures d'accès varient selon les régions et certains signalent toujours des taux inférieurs d'accès. Contrôlant pour les tendances temporelles, les différences fixes entre les régions, et les caractéristiques individuelles, l'accès déclaré ne change pas de manière significative avec l'augmentation de la participation aux GMFs.

Un meilleur accès aux soins de santé de première ligne constituait l'un des principaux objectifs explicites de la réforme des soins de santé de première ligne de 2002. Mes résultats suggèrent que l'augmentation de la participation aux GMFs n'a pas amélioré plusieurs mesures importantes d'accès. En conséquence, des politiques supplémentaires pourraient être nécessaires pour accroître l'accès potentiel aux soins de santé de première ligne.

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With the opportunity to recognize all the individuals and institutions who contributed in large or small ways to my master's thesis experience I must start with my extraordinary supervisor, Erin Strumpf. My thesis topic was very close to my personal research interests and Erin wholeheartedly supported my choice and contributed invaluable advice on data sources and analysis techniques that shaped the whole of my project analysis. Erin's countless and very detailed revisions, edits, comments and suggestions have made the analysis and writing processes both enjoyable and challenging; I always want to make her – and myself – proud. I thank Erin for providing me with funding and helping me to attend so many interesting conferences this past year. Lastly, Erin, I want you to know my immense appreciation for your support for a fledgling researcher (that's me) and for encouraging me in all my pursuits. I've learned so much from you and feel ready to face the world.

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Introduction

Primary health care is at the front line of patient health care service delivery. In general, a stronger primary health care structure reduces the burden on emergency services and specialized care and is associated with better overall health in the population and a reduction in health disparities (Starfield, Leiyu, & Macinko, 2005).

Primary health care is the most common point of entry for a patient into the health care system. Without access to primary health care, an individual's capacity to receive accurate diagnosis, care for both acute and chronic conditions, and specialized care, may be jeopardized. In all of Canada, Quebec is ranked last among provinces in the percentage of the population having a family doctor (Eisen, 2010) with predictions that the deficit of family physicians will continue to grow each year (Zins Beauchesne and Associates, 2007).

The lack of physicians has been coupled with often fragmented forms of care, poor chronic disease management and a lack of preventive care. Much has been made of recent primary health care reforms that seek to integrate care through multidisciplinary teams of health care providers to ensure continuity of care and appropriate disease management, and to emphasize health promotion and preventive care (Hutchison, Levesque, Strumpf, & Coyle, 2011; Romanow, 2002). In Quebec, the *groupes de medicine de famille* (GMFs) that were introduced in 2002 emphasized team-centered approaches to integrated delivery of care and were envisaged as an important means of lowering emergency department use while improving general population health (Clair, 2000). However, there remains a shortage of information measuring the impacts of GMFs on health outcomes, health care utilization, costs, and the accessibility of health care services.

Most often access studies use utilization rates as a proxy for access. Such measures will only be able to describe who sought out and was successful in accessing health care – i.e. realized access. Another type of study surveys identified *users* of primary health care regarding experience of care and perceptions of access. Inclusion in such studies is conditional on already having accessed primary health care and results would be no more applicable to the general

population than studies assessing utilization rates. Starfield argues that studies at the facility/clinic level can grossly underestimate the difficulty of accessing care as individuals with access difficulties are likely to be underrepresented in the sample (Starfield, 1992). I believe that *potential* access to primary health care – distinct from *realized* access – should be given equal consideration for research given its implications for an individual's ability to seek health services when necessary (R. Andersen & Newman, 1973). There are several measures of access that can capture different concepts associated with potential access including having a family doctor, and reporting unmet health care needs.

Previous research into the impact of GMFs has almost exclusively focused on patterns of utilization and experiences of access reported by patients enrolled in GMFs (Beaulieu et al., 2006; Levesque et al., 2012; Pineault et al., 2008; Provost et al., 2010; Tourigny et al., 2010). As well as failing to capture a population perspective on the impact of GMFs, these studies were performed early in implementation and comprised a relatively short study length averaging around two years.

Given the lack of appropriate research thus far, the major aim of my research is to evaluate the longitudinal population impacts of the introduction of GMFs on primary health care access in Quebec. I use various concepts and measures of access to capture as broad a picture of primary health care access as possible. From 2001 to 2010 my study covers the period prior to GMF introduction all the way to late within implementation. In addition I employ an econometric analysis design that seeks to estimate the causal average treatment effects of GMF implementation on my various measures of access. My specific research questions are as follows:

- Potential access to primary health care
    - Has the GMF program increased potential access to primary health care?
    - Specifically, do more Quebec residents report having a regular doctor following its implementation?
- Potential access at different times of day
    - Has potential access to primary health care improved during usual clinic hours?
    - Have the GMF requirements to provide after-hours access to primary health care impacted reported access during evenings, weekends and nighttime?

- Realized access to primary health care
    - Has the appropriate use of preventive services changed in response to GMF implementation?
- Barriers in accessing primary health care
    - Has GMF implementation impacted reported barriers to accessing health care?
    - Which barriers are most often reported for impeding access?

My thesis is divided into three sections. Section I: Background covers background information on primary health care, access to health care, and primary health care reform in three chapters. Section II: Materials and Methods contains the materials and methods of my thesis with chapters covering data sources, variables used, and my study methods. Finally, Section III: Results and Discussion includes two chapters with results, discussion and conclusions from my analyses.

Section I: Background

1. Primary health care

The benefits of primary health care have been extensively studied, especially with regards to patient outcomes. It is generally accepted that a health care system founded on strong primary health care leads to better health outcomes, more equitable allocation of services, improved access to needed care and more efficient use of resources (Starfield et al., 2005). However, to study anything in the context of primary health care, we must first define it.

The World Health Organization (WHO) and the American Institute of Medicine (IOM) have both produced important definitions of primary health care. The IOM defined primary health care largely in terms of care performance or attributes including accessibility, comprehensiveness, coordination, continuity, and accountability (*Defining Primary Care: An Interim Report*, 1994). By contrast, the 1978 WHO definition from the declaration of Alma-Ata placed a greater emphasis on the role of primary health care as the basis of the health care system, the first point of access for a patient, and as encompassing public health responsibilities (*Declaration of Alma-Ata*, 1978). Jenkins argues that this inclusion of public health concerns broadens the scope of primary health care beyond biological determinants of diseases and conditions with the inclusion of social determinants of health (Jenkins, 2009). The 2008 WHO update on primary health care identified its core attributes as comprehensiveness, continuity, person-centered care, patient empowerment, enduring relationships, integration, and focus on health determinants (*Primary Health Care: Now More Than Ever*, 2008).

With her extensive research in primary health care, Starfield has become among the most important contributors to this field. For Starfield, primary health care can be generally characterised as supplying first contact, non-referred, as well as continuous patient care; it offers a broad range of services in response to a broad range of common yet poorly defined health problems that often have no specific diagnosis. Finally, primary health care seeks to promote, maintain and improve health by providing curative, preventive and rehabilitative services (Starfield, 1992).

In defining primary health care, Starfield focuses on the attributes she feels are unique to primary health care: first contact care or accessibility, longitudinality, comprehensiveness, and coordination. Accessibility defines first contact, non-referred care and is highly important for equity of access. However, access to health care is equally if not more varied in definition than primary health care and will be addressed in detail in the following chapter. Longitudinality of care goes beyond continuity, which Starfield argues is an attribute that can be achieved by any type of care, but constitutes a personal, long-term relationship between the patient and the primary health care provider where the provider is the regular source of care and the latter is recognized by both parties. Comprehensiveness involves the provision of all appropriate care as well as whole person care. All appropriate services requires a broad range of services to be offered that includes health promotion, prevention, diagnosis and treatment of common conditions, referral to other clinicians, and management of chronic conditions (Haggerty et al., 2007). Whole person or patient-centered care considers the functional/physical, biological, emotional, and social context of patient health (Haggerty et al., 2007; Starfield, 1992). Finally, coordination of care involves the management of patient care and coordination of experience within the system: screening and diagnostic testing external to the primary health care setting, and specialist and hospital diagnoses, treatments and resulting outcomes.

In keeping with the many conceptualizations of primary health care, Kringos et al. define primary health care as a multidimensional system comprised of the primary care structure, the primary care process and its outcomes (Kringos, Boerma, Hutchinson, van der Zee, & Groenewegen, 2010). The dimensions of the primary care process put forth by Kringos et al. are equivalent to primary health care attributes reported elsewhere.

Many other studies have attempted to conceptualize the attributes or domains of primary health care; some researchers have attempted to concentrate attributes into fewer underlying concepts (Franks, Clancy, & Nutting, 1997) while others generate more and longer lists of primary health care domains, sub-domains or dimensions (Haggerty et al., 2007; Hogg, Rowan, Russell, Geneau, & Muldoon, 2008). So muddied has the understanding of primary health care become that a report released by the Health Evidence Network (HEN) of the WHO Regional Office for Europe on restructuring health care systems provided a succinct definition of

specialist care but none for primary health care. An annex following the report was given over to the description of various methods of conceptualizing primary health care all leading to vastly different definitions including those based on level of care within the entire health care system, in terms of content or services offered, as a health care process, and based on type of health care professional present (Atun, 2004). The difficulty in settling on a single definition seems to arise from the many broad concepts with which primary health care has been described and that these concepts may be difficult to operationalize directly.

By far the largest focus of researchers when studying primary health care is to operationalize it through the attributes of the primary health care process because specific attributes are – generally – more easily defined and measured than broad characteristics of primary health care. Altogether, I *describe* primary health care structurally and organizationally as the backbone of health care system, the point of entry for majority of patients, and the largest source of regular care within the system; however, I conceptualize primary health care through the dimensions or attributes of the process of obtaining primary health care. Specifically, I utilize Starfield's attributes that define the primary health care process as accessible, longitudinal, comprehensive, whole-person centered, and coordinated. I believe that defining primary health care through attributes is the most relevant conceptualization available for investigating both access to health care and primary health care reform. Access to health care is itself a process and I later use the primary health care attributes in operationalizing access measures. Additionally, though primary health care reforms may differ substantially, their goals are concentrated on improving health outcomes largely by bettering the primary health care process. The following two chapters discuss these ideas.

2. Access to health care

Evaluating the impact of a health policy or some other exposure on access to health care represents several challenges. First, a consensus definition of access to health care is elusive and depends on the context, the research question, and the status/exposure/treatment being analyzed. Second, access must be conceptualized or operationalized before it can be measured meaning that any one measure is unlikely to capture the chosen definition of access let alone an entire operationalization of access. Multiple measures are often required to capture different facets and to produce a convincing picture of access to health care.

2.1 Defining access

In the literature there appear to be three main themes that I find relevant to my investigation into the impact of a health policy on access to primary health care: potential and realized access, dimensions of access, and barriers to access.

2.1.1 Potential and realized access

Some of the most influential work in access to health care has been published by Andersen and various colleagues over several decades. Various definitions of access were produced including utilization or use of health care services; as based completely on organizational or resource availability; and, simply, as means through which entry into the health care system is achieved (Aday & Andersen, 1974). However, through Andersen and Newman's model of health care utilization, the distinction emerged for potential access – i.e. factors influencing the potential of an individual to use health care services – versus realized access – the actual use of health care services. The utilization model included characteristics that enable the individual to secure health services through personal or community resources; however, emphasis was still placed on the external validation of these potential factors through measures of actual health care usage (Aday & Andersen, 1974; R. Andersen & Aday, 1978; R. Andersen & Newman, 1973).

In a later study, Andersen et al. explicitly examined the dimensions of potential and realized access stating that potential access is "…influenced by structural characteristics of the delivery

system itself and the nature of the wants, resources and needs that potential consumers may bring to the care-seeking process" (R. Andersen, McCutcheon, Aday, Chiu, & Bell, 1983). An enduring definition arose from the same study whereby access to health care is defined through "dimensions which describe potential and actual entry of a given population group to the health care delivery system" (R. Andersen et al., 1983). Though in a later review of his health care access model over the years, Andersen defined only resource characteristics as relating to potential access (R. M. Andersen, 1995).

Donabedian offered an interpretation of access along two lines: geographic accessibility and socio-organizational access. The former included all temporal and geographic availability of health resources (e.g. health facilities, health professionals) while the latter comprised all factors affecting accessibility, other than geography, that help or hinder attempts to obtain health care (Donabedian, 1972). I see those factors affecting attempts to access care, as well as resource availability, as falling in line with the concept of potential health care access.

Khan & Bhardwaj examine various dichotomies in access concepts: potential access and realized access; spatial (geographic) access and aspatial (social) access – as in Donabedian's concept; and access opportunity and access costs – i.e. opportunities to seek care and concomitant costs (Khan & Bhardwaj, 1994). Khan & Bhardwaj developed a typology of access based on these dichotomies whereby subtypes of access are potential geographic access, potential social access, realized geographic access and realized social access and where opportunity and cost are dimensions of each subtype. Importantly, Khan & Bhardwaj promote the application of realized and potential concepts to different contexts of accessing health care.

2.1.2 Dimensions of access to health care

Penchansky & Thomas are also important contributors to the literature on access defining five dimensions of access to health care: availability, accessibility, accommodation, affordability and acceptability (Penchansky & Thomas, 1981). Interestingly, many of these dimensions are similar to attributes of primary health care discussed in the previous chapter. Penchansky & Thomas define access as the 'degree of fit' between the health care system and the patient, where the degree is determined by the five attributes of the particular context. Availability, pertaining to

the adequacy of supply of health resources, is identified by Penchansky & Thomas as the dimension of access that allows entry into the health care system, which I again interpret as representing the potential aspect of access.

Specific to primary health care access, Kringos et al. report similar features as for general health care access: resources availability, geographic accessibility, accommodation, affordability, acceptability, utilization, and equality in access (Kringos et al., 2010). Based on the available literature, Kringos et al. contend that access to primary health care services influences primary health care dimensions and outcomes such as continuity, comprehensiveness, quality, equity in health, population health, patient satisfaction, as well as the overall strength of the primary health care system (Kringos et al., 2010).

2.1.3 Barriers in accessing health care

Gulliford et al. cite Penchansky & Thomas's dimensions of access as defining personal, financial and organizational barriers to service utilization (Gulliford et al., 2002). Personal barriers include individual perceptions of need, attitudes and beliefs about appropriateness or effectiveness of health care services and previous experiences in obtaining care. Financial barriers can involve charges for specific health services (even within a national health care system) but also include time costs from loss of work and travelling costs. Organizational barriers comprise organizational inefficiencies that lead to long wait lists and waiting times but may also arise from systematic variation in referral practices (Gulliford et al., 2002).

Inverse to access barriers are necessary steps in accessing health care. In one of the studies presented in a 2009 report for the *Institut national de santé publique du Québec* (INSPQ), Gauthier et al. examine the health system-user interface and develop five steps for accessing health care: identification of need, desire to obtain services, search for services, the first contact, and continuation of care (Gauthier et al., 2009). The third step, search for services, is identified as marking the passage between potential and realized access (Gauthier et al., 2009). While a health care need may eventually require any form of service (primary, secondary, tertiary), the initial search is commonly through the primary health care system. Indeed, Gauthier et al. further dissect the search for services (with an emphasis on primary health care)

into six phases: contacting a regular source of care, getting information on health service options, confirming the location and time of the service, planning and displacement, waiting room, and consultation. Searching for health care services can therefore be impeded by a lack of a usual source of care as the latter is often considered a resource potential in accessing care. Thus, by the process proposed by Gauthier et al., we can infer that the absence of a regular source of care represents a significant barrier in accessing primary health care.

2.2 Measuring access

Khan & Bhardwaj contend that both potential and realized definitions of access are not directly quantifiable and must be conceptualized in some way so as to be measurable. These authors conceptualize access as "the outcome of a process, determined by an interplay between characteristics of the health care service system and the characteristics of potential users in a specified area, and moderated by health care related public policy/planning efforts" (Khan & Bhardwaj, 1994); the outcome of this process might be patient satisfaction, utilization, or patient health outcomes. But, though Khan & Bhardwaj use potential aspects of access in their conceptualization, any outcome measure is, necessarily, a measure of realized access. Aday & Andersen also conceptualize access through potential and realized elements and recommend measures of utilization including specific type of care used, the site of receipt of services, the purpose of the visit and the time involved from seeking to receiving care – again, solely measures of realized access – for quantifying access to health care (Aday & Andersen, 1974).

Among the most important contributions to the operationalization of access is the previously mentioned health services utilization model from Andersen & Newman (R. Andersen & Newman, 1973). This model has influenced countless studies and made health service utilization among the most prevalent measures employed in studies of health care access. An overview is presented below.

Andersen & Newman began with a framework for studying health services utilization that comprised three determinants: societal, health services system and individual (Figure 2.1). Societal and health system determinants are presented as affecting utilization through

individual determinants. Societal characteristics involved medical/health care norms and compliance, and availability/usage of technology. This determinant of health care utilization is difficult both to fully conceptualize and to measure. Health services system characteristics are comprised of resources and organization which are further classified by volume and distribution, and access and structure, respectively. Volume represents the supply of resources, whereas distribution characterizes geographic availability. The access component of the organization of health systems refers to the process of entry and continuation of care in the health system; and structure of organization indicates determinants of health care experience (type of care, contact with various health professional, etc.) once entry has occurred.

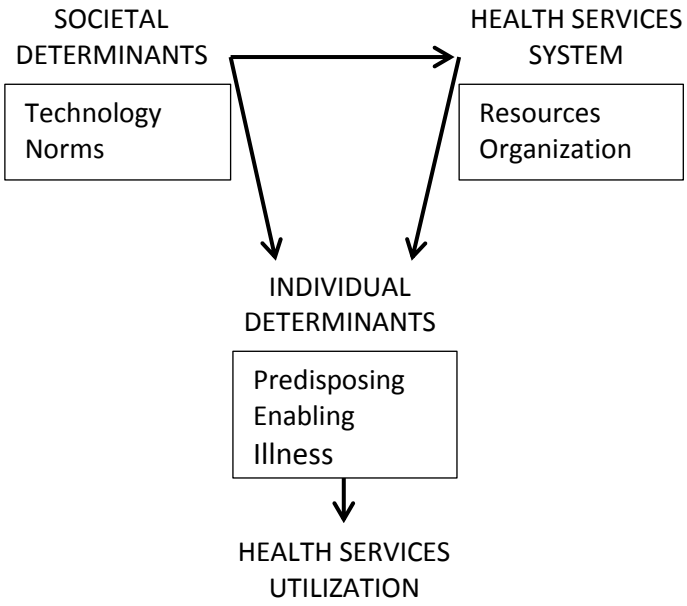

Figure 2.1 Framework for studying health care utilization. Adapted from Andersen & Newman, 1973.

Individual characteristics are categorized based on theories of association with utilization and to guide variable selection in anticipated implementation of the model in differing contexts. Three characteristics of individual determinants proposed by Andersen & Newman are predisposing, enabling and health need. Predisposing characteristics are largely immutable characteristics – i.e. non-manipulable and unchangeable through social policy implementation – inherent to an individual that exist, perforce, prior to any specific illness and impact the propensity of an individual to use health care services. Demographics (e.g. age, sex, ethnicity), social status/position variables (e.g. education and occupational status) and attitudes or beliefs

regarding medical care or the health care system (e.g. captured through culture or levels of confidence), comprise the predisposing category. Overall, predisposing characteristics are seen to represent individual disposition toward use of health care services and not as direct reasons for utilization.

The second component of individual characteristics is the presence of enabling conditions or resources. Enabling characteristics are those that impact an individual's ability to secure health care and can be beneficial or detrimental and are generally manipulable. Personal/familial enabling characteristics can include income, health insurance status, and having an appropriate and accessible source of care. Community context can also impact conditions and resources; supply and affordability of services within a given area can be important for local utilization. In addition, geographic location of the individual relative to the health care services is relevant for potential geographic access. Apart from resource availability, location can impact social or normative behaviour of the individual within the community.

Andersen & Newman label the final individual characteristic component 'illness level' but which I will refer to simply as 'health need' in an effort to include health care need beyond the disease state. Andersen & Newman identify an individual's level of need as the most likely cause for usage of health care services; need is also considered to be the equitable determinant of health care utilization with level of need determining actual usage of services. Need can be self-perceived or evaluated by a health professional and both concepts contribute to the model of utilization. Self-perceived need can be important for an individual's health-seeking behaviour; measures include self-perceived health status, perception of symptoms and illness, and their severity. By contrast, evaluated need may influence a health professional's decision to supply services. Andersen & Newman report that evaluated need is difficult to measure, especially the specific evaluated need that causes utilization.

Despite the emphasis of the 1973 framework as a model of utilization, Andersen et al. employed health system and individual predisposing, enabling and need characteristics as indicators of potential access in a factor analysis of the dimension of realized and potential access to health care services (R. Andersen et al., 1983). Though the factor analysis was meant

to determine indicators for potential access that load onto – i.e. explain – realized access indicators, I believe that the determinants and components of Andersen & Newman's model can be appropriately utilized in studies of potential access to health care. Health system resources and organizational accessibility, and individual predisposing, enabling and need characteristics can all be interpreted through the lens of potential access. Supply and geographic availability of resources as well as enabling individual and community conditions and resources are easily identified as impacting an individual's ability to access health care. Need factors, in a health care system founded on equity of access, can affect the probability of accessing care, especially in the context of limited resources. If predisposing characteristics do not seem so directly reflective of the concept of potential access, Jenkins argues that their inclusion can be justified since characteristics impacting utilization are equivalently important in impacting potential access (Jenkins, 2009). As the potential to access care must be present prior to actual use of services, I agree with this assertion.

2.3 Access studies – Canadian context

Access to health care can mean implicitly different things in different health care systems. For example, in the United States, having health insurance is often synonymous with having access to health care; whereas in Canada, with a single payer system, the possession of health insurance is much less important and measures of access are more often associated with wait times.

For example, in a study of Canadian access to health care, Torgerson et al. identify access as "the right service, at the right time, in the right place or context" and use Penchansky & Thomas's dimensions of access to identify access barriers of availability, spatial accessibility, accommodation and affordability (Torgerson, Wortsman, & McIntosh, 2006). Torgerson et al. also identify a temporal dimension of access that is particularly relevant to the Canadian experience of health care while stressing that access and barriers are always context dependent (Torgerson et al., 2006).

The Torgerson et al. definition inferring the intersection of time, context and service appears repeatedly within Canadian studies of access to health care. Haggerty et al., in a 2007 study documenting the consensus among primary health care experts in Canada, produced an operational definition of first-contact accessibility of "the ease with which a person can obtain needed care (including advice and support) from the practitioner of choice within a time frame appropriate to the urgency of the problem" (Haggerty et al., 2007).

Despite the large literature on defining and conceptualizing access, studies on access to health care often remain vague on the precise form of access being investigated and we must infer the intended definition based on the measures employed.

Many different measures of access have been used in recent Canadian studies. Several use some variation on having a primary health care physician (Breton, Ricard, & Walter, 2012; Glazier, Kopp, Schultz, Kiran, & Henry, 2012; Haggerty et al., 2004; Jenkins, 2009); some of these emphasize the concept of potential access while others make little distinction between access definitions. Often self-reported unmet health care need is used to measure access problems (Gauthier et al., 2009; Levesque et al., 2012; Wu, Penning, & Schimmele, 2005) with reported barriers to accessing care and difficulty accessing care also capturing this concept (Kapetanakis, Ouellet, & Pineault, 2008; Sanmartin & Ross, 2006; Wellstood, Wilson, & Eyles, 2006). While the measure of having a primary health care physician may be reasonably objective, self-reported unmet needs, difficulty accessing care and barriers to access are fairly subjective. Other subjective measures include patient experiences of accessing care and patient perceptions of access (Wellstood et al., 2006). By contrast more objective measures may use health care systems and processes of access, the number of FTE-physicians per capita in a given region, wait times for a new consultation, next day appointment availability, and administrative utilization data (Bell, Wilson, Bissonnette, & Shah, 2012; Crooks & Schuurman, 2012; Glazier et al., 2012; Lebrun & Dubay, 2010).

2.4 My definition and measures of access

We can now see why it was important in the previous chapter to define primary health care so carefully; because the definition of access – either potential or realized, geographic or socio-organizational, opportunity or cost – is always context dependent. My definition of access to primary health care – especially since I have chosen to largely focus my study on potential access – relies greatly on which health care services I wish to investigate. The accessible, longitudinal, comprehensive, and coordinated attributes of my chosen definition of primary health care are most often identified within a long-term patient-physician relationship. Thus the potential to access such a form of health care can be possessed by an individual through having a regular physician with whom an appointment can be made without referral, with whom a longitudinal relationship exists, and who provides comprehensive, whole-person, coordinated care.

Care from a regular physician naturally conforms well to the attributes of primary health care; however, having a regular physician is also an important indicator of potential access to primary health care. As previously discussed, Gauthier et al.'s process of accessing primary health care relies on a regular source of care during the search phase that follows the recognition of need and the decision to act (Gauthier et al., 2009). In addition, a 2004 report on the conditions of access in Quebec placed an emphasis on how the lack of a primary health care physician is detrimental in accessing needed services (Haggerty et al., 2004). In an early study of access to primary health care, Lambrew et al. investigated the impacts of having a regular source of care compared to having a regular doctor and concluded that both are important indicators of potential access but that the two conditions do not necessarily lead to the same experience of care (Lambrew, Defriese, Carey, Ricketts, & Biddle, 1996).

The specific measure I will use to measure potential access in having a regular physician is a Canadian Community Health Survey (CCHS) question that asks respondents whether they have a regular medical doctor. Other ways of conceptualizing potential access are through unsuccessful attempts to obtain access to care, the reverse of that positive potential measured

by having a regular physician. Reports of unmet health care needs and difficulty accessing certain forms of care represent my measures of absence or lack of potential access.

Though potential access to primary health care is extremely important and the main focus of my study, I also investigate realized access – specifically the receipt of appropriate preventive health services – to examine another facet of access to health care. Among the preventive services surveyed in the CCHS, I chose to use receipt of an influenza shot, a mammogram and a Pap test. Each of these services has a corresponding Canadian guideline recommending the sub-population, age, and interval for appropriate use. I examine whether these forms of preventive care are received by the correct groups and in accordance with recommended guideline intervals.

Finally, I investigated barriers to accessing specific health care services. CCHS respondents indicating an absence of access – e.g. reporting unmet health care needs, or not receiving the appropriate preventive service – can specify one or more reasons why they feel they lacked access. I use the dimensions and barriers of access described by Penchansky & Thomas, Gulliford et al., and Torgerson et al. to classify the reasons into categories of barriers relevant to the Quebec context. Those barriers are geographic availability barriers – i.e. the relative location of primary health care services and the individual; temporal barriers – wait times for services or availability of service at the appropriate time; personal barriers – decision to seek care, responsibilities, beliefs, etc.; and financial – service charges but also personal cost in time and income from transit and work absence.

3. Primary health care reform

More than a decade ago now, a recognition emerged that emphasis on medical treatment and hospital care was a highly inefficient and ineffective means of providing health care to Canadians (Romanow, 2002). Emergency department (ED) and hospital care are among the most expensive forms of care and it was proposed that better primary health care would use resources more efficiently, reduce the number of visits to EDs and hospitals for minor problems or effects of chronic conditions, and finally shift emphasis from acute care to illness prevention and health promotion. However, making too many changes all at once was identified as a major barrier to reform – where should health policy reform be concentrated? The Romanow Report identified six main deficiencies in the Canadian system: a main focus on hospital and medical treatments, increasing specialization of physicians with fewer going into family medicine, fragmented health care delivery with a complete lack of continuity of care, patients having limited control over their own care, and a deficiency of preventive care and health promotion (Romanow, 2002).

3.1 PHC reform in Canada

Several recommendations were made in the Romanow Report in response to these deficiencies: increasing the supply of family physicians and nurses, ensuring appropriate geographic distribution of health care providers, and a focus of primary health care on helping Canadians "access teams and networks of health professionals." Romanow considered that combining the mix of skills found in teams of diverse health care professionals as among the best methods for producing high quality primary health care. The 2003 First Ministers' Accord on Health Care Renewal and the 2004 10-Year Plan to Strengthen Health Care examined the whole of the publicly funded Canadian health care system but also placed a special emphasis on interdisciplinary teams for improving primary health care (Health Council of Canada, 2007).

Since the release of these pivotal reports and others produced by various provincial commissions, many different primary health care reforms have been attempted across Canada. These reforms include interdisciplinary team-based models of primary health care,

groups/networks of primary health care providers, different physician remuneration schemes, incentives, rostering of patients, and formal contracts between primary health care providers and health authorities (Hutchison et al., 2011). The paper by Hutchinson et al. offers a comprehensive overview of the reforms being implemented across the country in the last decade. The provinces of Ontario, Quebec, and Alberta have seen some of the most dramatic changes with large scale implementation of integrated team-based models of primary health care. Importantly, while other provinces and territories may have emphasized other approaches, – such as changes to physician payment schemes in British Columbia – they have all been exposed to pilot or demonstration projects or small scale (not system wide) implementation of various team-based model of primary health care.

3.2 Characteristics of team-based models

Interdisciplinary team-based models of primary health care are founded on collaboration between physicians, nurses and other health care professionals. The Romanow Report stresses how team-based models of primary health care can be a catalyst for changing traditional scopes of practice and ensuring a sufficient mix of skills within a team of health care providers to deliver suitable care for all patients (Romanow, 2002). For physicians, the latter means reducing the emphasis on specialization and protecting scope of practice, and encouraging flexibility in care provision and sharing of responsibilities, as well as a shift away from medical treatment and toward health promotion and prevention. Among nurses working in these team-based models, an expanded role in providing basic and follow-up care to patients, and participating in care coordination is expected. Finally, scope of practice for other health professionals can also be impacted; for example, pharmacists can coordinate with physicians in the proper management of prescription medication.

Team-based organizations are often integrated within the health care system and coordinate different forms of patient care through a local health center. Different organizational models of team-based care exist; the most basic dichotomy being community-based – where care is provided to a specific population defined by a geographical area – and professional-based – where care is provided to individuals seeking care or those registering with the organization.

Within community and professional models, further categorizations are possible as discussed generally by Lamarche et al. and within the Quebec context by Pineault et al. (Lamarche et al., 2003; Pineault et al., 2008).

Other characteristics of team-based models often include ensuring accessibility of care during all hours of the day, but with special provisions for evenings, nights and weekends. Remuneration schemes other than fee-for-service are often used along with other incentives to encourage specific practices. Generally, team-based models emphasize patient-centered care, enhanced accessibility, long-term relationships between physicians and patients, coordination of care between different providers, and continuity of care (Romanow, 2002). Altogether, it appears as though teams of health care professionals are meant to reflect those ideal attributes of primary health care discussed in chapter 1 that include accessibility, longitudinality, comprehensiveness and coordination.

3.3 Groupe de médicine de famille

Quebec's g*roupes de médicine de famille* (GMFs) were first introduced in November of 2002 and generally match the professional coordination model described by Lamarche et al. in which physicians and nurses work together to provide long-term coordinated care to registered patients (Lamarche et al., 2003). However, not all GMFs follow the same organizational type with some falling more along the lines of a community model or a professional contact model (Pineault et al., 2008). The general GMF model was established following two specific recommendations given in the Clair Commission of 2000. First, that the medical component of the primary health care system be taken on by groups composed of general practitioners and nurse clinicians or nurse practitioners; and second, that these groups be responsible for a broad range of defined services towards a population of individuals choosing them as their primary health care provider (Clair, 2000). In practice, GMFs generally consist of 6-10 full-time equivalent (FTE) primary health care physicians working in collaboration with one or more nurses and administrative support staff (Hutchison et al., 2011; Vedel, Monette, Beland, Monette, & Bergman, 2011). Other health care professionals, such as nutritionists or physiotherapists, may also practice within the GMF in conjunction with physicians; however,

this latter form of collaboration is less common. Individual physicians forming a group, or existing groups practicing in clinics, family medicine units and CLSCs (C*entre local de santé communautaire*) were eligible to become GMFs which allowed this model to be implemented in both the private and public spheres of the health care system[1]. Each GMF is overseen by one responsible physician and may consist of more than one site (Ministère de la santé et des services sociaux, 2008).

On an organizational level, GMF program goals included improving accessibility and delivery of services, as well as developing greater complementarity of services between primary health care physicians and their local CSSS (*Centre de santé et services sociaux*). At the patient level, the goals of the GMF policy aimed to improve patient management and monitoring of enrolled patients, to provide greater quality of care, and increase the number of people with access to a family doctor with the eventual objective of ensuring that all Quebecers have a family doctor (Émond et al., 2006).

Aside from the introduction of an integrated team-based model of care, GMFs also include several other primary health care reform approaches that were identified by Hutchison et al.: formal agreement between the GMF and a government health authority, rostering of patients that includes a contract, and human, financial and resource incentives.

To become a GMF, a group of physicians proposes an offer of defined services to be provided with specific reference to the days and hours of clinic operation, and availability of home care and services outside the clinic. The offer then becomes the subject of an agreement between the group and the regional ASSS (*Agence de la santé et des services sociaux*) and the group is accredited as a GMF for a period of three years by the MSSS (*Ministère de la santé et des services sociaux*). Before renewal of accreditation can be obtained, an evaluation of the service offer is undertaken where the GMF must demonstrate that the agreement on service provision was respected.

[1] Hospitals, CLSCs and other regional and municipal health agencies and centers funded by the Quebec government are considered public. Physicians working in solo or group practices outside of these establishments are considered to operate in the private sphere even though they are remunerated by the government through fee-for-service billing. Thus a GMF originating from a CLSC operates in the public sphere whereas a GMF emerging from solo or group practices operates in the private sphere (or mixed sphere due to the extra GMF funding).

Patient enrollment is another essential element of a GMF. Patients voluntarily sign a one year contract designating a member physician of a GMF as their family physician; the contract guarantees the availability of service with or without an appointment. If the patient's family physician is not available, a nurse may provide the necessary care, or, in an emergency, another physician of the GMF can provide care to the patient. The contract does not require anything of the patient and, at any time, the patient can cancel their enrolment with the GMF; otherwise the contract automatically renews (Ministère de la santé et des services sociaux, 2008). With the introduction of GMFs, general guidelines estimated that between 1000-2200 patients should be enrolled per full-time equivalent GMF physician, with an average of 1500 patients per FTE-GMF physician (Émond et al., 2006).

Finally, the GMF program offers a limited set of financial incentives. While fee-for-service physician billing remains the dominant method of payment, other remuneration strategies were put in place. An annual lump sum for every patient enrolled is provided; this financial incentive is in addition to the general incentive available to any family physician for enrolling vulnerable patients – those over 70 years of age and/or with chronic conditions. Remuneration for time spent on consultations outside of regular hours is provided along with a bank of paid hours to compensate physicians for time spent on administrative duties; lastly the physician responsible for the GMF receives an annual compensatory lump sum. Aside from remuneration, other financial incentives include covering nurses' salaries, supplying the expected salary for an administrative assistant and a secretary, and assistance with rental costs. Physical resources such as computers, software and telecommunication links are also made available (Ministère de la santé et des services sociaux, 2008).

The GMF policy clearly reflects the key attributes of primary health care put forth by Starfield. GMFs provide several means of expanding access to care through file sharing, nurse appointments, and after-hours walk-in consultations, among others. Longitudinal relationships between physicians and patients are encouraged by patient enrollment with one physician responsible for their care. An emphasis on health promotion and prevention goes beyond the standard provision of medical treatment towards ensuring comprehensive patient care. And

collaboration with nurses and links to local health organizations are meant to ensure proper coordination of care.

As for my measures of access to primary health care, I believe that if the GMF program succeeds in providing more Quebecers with a family doctor by enrolling more patients with physicians in GMFs, then my measure of potential access for reporting a regular medical doctor should be positively impacted in response to greater GMF participation. Similarly, if more individuals have expanded access to primary health care through GMFs, then reports of unmet needs and difficulty accessing care should decrease. Finally, as team-based models, including GMFs, place a strong emphasis on health promotion, I would expect the appropriate use of preventive services to increase as GMF participation also increases.

3.4 Primary care reform and access

Following the Romanow Report and the 2003 First Ministers' Accord, the Health Council of Canada has released several reports updating the progress of health care reform efforts across Canada (Health Council of Canada, 2007, 2008, 2011). These reports examined general health outcomes, access to health care – with access measures mostly defined through wait times – and quality of care. In summary, these reports found that implementation of interdisciplinary teams of primary health care has proceeded slowly and at very small scales in most provinces aside from Ontario, Quebec, Alberta, and Saskatchewan; 24/7 access to care was generally of poor quality and not improving over time; and wait times have improved for some specific services but not all.

An interesting study by Glazier et al. investigated access to primary health care following the introduction of Ontario's Patient Enrolment Models (Glazier et al., 2012). They found that patient attachment to a primary health care physician increased between the years 2005/2006 and 2010/2011 from 91% to 95% of the Ontario population. Other measures of access such as ability to obtain a next day appointment and visits to walk in clinics or emergency departments did not improve. Glazier et al. suspect that enrollment incentives are associated with the increase in proportion of the population with a family doctor, while other remuneration

schemes and financial incentives specific to the various models did not promote more accessible or higher quality care but may have actually discouraged physicians from accepting sicker patients and recommending other sources of care.

In Quebec, a large study on the earliest adopters of the GMF program – the first nineteen GMF clinics established between November 2002 and April 2003 – was undertaken by the MSSS to investigate elements of actual GMF practices and the effects of these GMFs on services including accessibility, continuity of care, and service utilization (Ministère de la santé et des services sociaux, 2008). The study involved surveys, interviews and panel discussions in 2003 with follow-up in 2005.

At the time of initial data collection, just following accreditation for most GMFs in the study, the majority of GMFs offered extended walk-in clinic hours at least one night per week and on the weekend. However, by the two year follow-up period, a significant and dramatic decline was recorded in the number of GMFs with extended evening and weekend hours of service; somewhat shockingly, among affiliated GMF sites in 2005, only 35% offered evening hours and none offered weekend hours. Despite the dramatic reduction in clinics opening outside of usual hours, the MSSS study found a significant increase from 2003 to 2005 in the proportion of patients reporting greater access to after-hours care, principally through the potential to contact an individual from their GMF outside of usual clinic hours and the potential to see their family physician in case of an emergency.

Other access measures such as general ease of access to the clinic, convenience of opening hours, and communication with GMF personnel did not change importantly. As well, patients' perception of access to a physician during opening hours did not significantly improve; however, patient loyalty to one physician (or one clinic) greatly increased, mainly at public GMF sites, and patients felt that their physician had a better understanding of them and their personal, social and health contexts at the time of study follow-up compared to the initial assessment.

The MSSS study found generally stable utilization patterns across the GMFs studied between 2001 and 2006. The number of physician appointments in all clinics – both GMFs and

comparably sized non-GMF clinics – decreased during the study period; however the drop occurred much more rapidly in GMFs. A concomitant increase in the use of nursing services was observed in GMFs, a change expected due to the expanded role of nurses in the provision of certain services within GMFs.

GMFs and comparable non-GMF clinics had similar numbers of practicing physicians but GMFs had a greater number of full-time equivalent physicians because fewer GMF physicians practiced part time within the clinic compared to the non-GMF clinics. Thinking of my main definition of potential access to primary health care, the greater number of FTE-GMF physicians per clinic might indicate a potential to enroll more patients thus increasing the number of individuals reporting having a family doctor. Above I discussed the expected number of patients to be enrolled per GMF physician. Once physicians formally enrolled their existing patients, most found their total to be much less than expected and expressed great doubt about their ability to enroll more patients and continue to provide an appropriate level of care. Additionally, some GMFs began to decline access to walk-in consultations for non-enrolled individuals because they felt it would otherwise compromise the care of enrolled patients towards whom the physicians felt an increased responsibility following the signing of a contract.

Other studies have similarly been conducted within a small number of GMFs in the early years of implementation. Beaulieu et al. examined five GMFs from different origins (public, private, mixed[2]), locations and contexts over a similar period beginning in 2003 and with follow-up in 2005 and found an increase in reported accessibility both during regular clinic hours and outside of regular clinic hours (Beaulieu et al., 2006). Tourigny et al. performed a similar study of five GMFs in Montreal and Montérégie with the first assessment performed 15-20 months after initial accreditation and with follow-up 18 months later in the winter of 2006. Their evaluation of patients' perceptions of quality of care indicated that perceived accessibility did not change between baseline data collection and follow-up even though patients reported increased use of after-hours services and increased use of nurse services (Tourigny et al., 2010).

[2] See Footnote 1 for more information on public, private, and mixed health care settings.

Comparing models of primary health care and types of primary health care organizations in Quebec has also been done. Pineault et al. classified the various forms of primary health care organizations in Quebec into five models. Solo practices ranked first in nearly all accessibility measures except financial accessibility. Primary health care organizations falling into Pineault et al.'s coordination and integrated coordination models, that mainly describe GMFs, ranked second in most access measures but higher in service productivity, and performance of the primary care organizations relative to their corresponding models' ideals and potential (Pineault et al., 2008). Comparing public, private and mixed primary health care organizations – where private GMFs are classified as mixed due to the large amount of public funding – Provost et al. found that better clinical preventive care was delivered in public and mixed organizations (Provost et al., 2010).

Altogether, the available evidence suggests some increase in access to primary health care outside of usual clinic hours, a greater role for nurses within GMFs, better provision of preventive care and a total decrease in the number of physician appointments. However, from the MSSS study, little change in the number of individuals enrolled per FTE physician may indicate that, early in GMF implementation, this model of primary health care has not succeeded in improving access for individuals who did not already have a primary health care physician. In addition, all the above studies have focused on patients within GMFs and have failed to examine one of the main GMF program goals of increasing the number of Quebecers with a family physician. These studies have either been cross-sectional or used a small window early within program implementation that may have been insufficient to capture effects of truly established GMFs. Finally, the MSSS study examined the first 19 GMFs implemented in two health regions of Quebec, data from 10 of which contributed to patient experience measures; the other studies discussed here all used 5 GMFs for their data collection. The small number of GMFs included, from a maximum of two health regions, cannot give a clear picture of how all GMFs operate within the large and diverse province of Quebec.

In addition to the above limitations, these studies have been purely observational and have not employed sufficient methods to identify anything beyond correlations between exposure to

primary health care reform and reported access. When reporting ‘effects’ or ‘impacts’ or ‘results’ of an exposure, these words infer causality. To obtain a causal effect of an exposure on an outcome, the exposed and control groups must be exchangeable. The latter implies that both groups would have experienced the same outcome given the same exposure status. Therefore, a common distribution of exposure probabilities should exist between the two groups. In the context of access to health care and GMFs, we know that many factors influence access (discussed in chapter 5) and it also been shown that there are differences between physicians and patients who participate in the GMF model and those who do not (Coyle, 2011). As such, a common distribution of probabilities of GMF enrollment between GMF patients and non-GMF patients is unlikely to be present; therefore comparing these non-exchangeable groups will not isolate a causal impact of the GMF program on access to primary health care.

Overall, there has been a lack of studies into the longitudinal population (causal) impact that the implementation of the GMF program has had on access to primary health care. This is the gap I intend to fill with my thesis work.

Section II: Materials and Methods

4. Data sources

4.1 CCHS: dependent variables and covariates

The Canadian Community Health Survey (CCHS) is an ongoing, nationally representative, cross-sectional survey of Canadians which provides information on health determinants, health status and health system utilization. The target population consists of persons twelve years and over living in all ten provinces and three territories of Canada; however, the CCHS does not include individuals living on reserves or other provincial Aboriginal settlements, full-time members of the Canadian forces, or the institutionalized population. In addition, certain remote regions such as the two Quebec health regions of Nunavik and Terres-Cries-de-la-Baie-James[3] and roughly 30% of the Nunavut population (those living outside the ten largest communities) are not sampled. Overall, the CCHS sampling represents close to 98% of the target Canadian population (Statistics Canada, 2011).

The first cycle of the CCHS was conducted in 2001 with eight cycles completed by 2012. In the first three cycles, data collection occurred in two-year cycles with the first year of each cycle designated with a '.1' and the second year with a '.2'. The .1 surveys consist of a large general sample of the Canadian population with sufficient sample size for reliable estimation at the health region level. The .2 surveys were conducted on a smaller sample for specialized topics with estimation reliable at the provincial level. Beginning in 2007, the CCHS was reformatted to become an annual survey with ongoing sampling. The sample size was also decreased from roughly 130,000 persons in the .1 portion of the two-year cycles to 65,000 in the annual cycles (Statistics Canada, 2001a, 2008b).

For this study, I was granted access to microdata files of the first seven waves of the CCHS (1.1 (2001), 2.1 (2003), 3.1 (2005), 2007, 2008, 2009 and 2010; CCHS 2011 not having been released at the time of my application) through the Social Sciences and Humanities Research Council of

[3] Terres-Cries-de-la-Baie-James was available in cycle 2.1 only.

Canada (SSHRC) at the Research Data Center of the McGill-Concordia branch of the Quebec Inter-University Center for Social Statistics (QICSS). I recoded the data and created variables in each cycle individually, merged each with the bootstrap data file, and finally appended the seven cycles together. The bootstrap data file includes the variables necessary to account for the complex survey design of the CCHS. I restricted my dataset to CCHS respondents who are Quebec residents, eighteen years of age and older, and not resident in any of the three health regions of Nunavik, Terres-Cries-de-la-Baie-James or Nord du Quebec at the time of the survey. Combining the repeated cross-sectional datasets allows me to examine changes over time in access to primary health care and reported barriers among the Quebec population.

4.1.1 Challenges and solutions for using CCHS data

4.1.1.1 Merging across cycles

As with many repeated cross-sectional surveys, combining CCHS cycles can present certain challenges[4]. The CCHS contains common content, optional content and sub-sample content with the latter treated separately from the first two. The common content is common to all respondents whereas the optional content is chosen at the provincial or health region level; and sub-sample content is collected from a sub-sample of main survey respondents. Importantly, while many common content modules are maintained with little change each cycle, not all are collected every year and some are modified between cycles. For example, data on physician-diagnosed chronic conditions are collected at each cycle of the CCHS; however, the same set of chronic conditions is not always included each year. Similarly, variables can undergo coding changes such as the multi-level urban-rural geography variable that exists variously with five and seven levels and with different level definitions. Most of the coding differences occur between the first four cycles; cycles 2007 through 2010 show much greater consistency.

[4] Now a document named Content Tracking Tool for the CCHS produced and updated by PHIRN (Population Health Improvement Research Network) provides information on coding and content and flags certain variables and modules based on their suitability for combining across cycles.

Like common content, optional content may be repeated across cycles or offered only once. Often, optional content is available but certain provinces or health regions do not choose to include it in the questionnaire for their residents. The optional Physical Check-up module, as an indicator highly relevant to primary health care accessibility, is selected for Quebec health regions only during CCHS 2008 data collection. Optional content is not generalizable across Canada, but within a province in which all health regions have selected a particular module, estimation is reliable at both the provincial and health region level. Repeated optional modules can vary slightly between years; coding, definitions and universe of respondents must be carefully examined before combining across cycles.

Sub-samples, depending on the cycle, can range in number from one to three and content is often related to a cycle theme. Unlike common and optional content, sub-sample content has a limited sample size that is distributed between the provinces to achieve reliable results at the national and provincial level as opposed to the health region level (Statistics Canada, 2005). However, a study using the 2003 sub-sample to investigate difficulty accessing health care reported that, given the CCHS design and the number of 2003 sub-sample respondents, that analysis could be undertaken at the health region level but only in Quebec and Ontario (Kapetanakis et al., 2008). I will therefore use the sub-sample data with caution, taking into account their use in previous studies.

4.1.1.2 Weighting and bootstraps

In addition to issues of coding and content, each CCHS cycle is weighted to represent the entire Canadian population; the pooled sample weight variable in the combined dataset will therefore over-represent the Canadian population by a factor of seven. A rescaling of the weight variable is therefore necessary for appropriate use in data analysis. I implemented this rescaling by multiplying the weights of each survey year by the proportion of each year's sample relative to the sample size of the combined dataset (Charters, 2011; Thomas, 2006).

Because the CCHS has a complex survey design, unbiased variance cannot be achieved using standard estimation procedures. Statistics Canada requires that a re-sampling method be used and thus provides a set of bootstrap weights for each cycle of the survey. As with the standard

sampling weights, the bootstrap weights for each survey must also be adjusted after merging the seven data files. The rescaling process for the bootstrap weights is identical to that of the sample weights.

4.1.2 Variables from the CCHS

Here follows a brief overview of the CCHS and HSAS (section 4.1.3) variables used in my study. An extensive description of CCHS and HSAS variable source, definition, coding, reasons for inclusion and use in analysis follows in chapter 5 Variables.

From the main cycles of the CCHS, I extracted data for independent and dependent variables as well as covariates for use in my analysis. Two of the main independent variables are health region and year, which are jointly used to assign the exposure of interest. A health region is the unit of analysis in my study and is assigned based on respondents' residence; year is assigned according to which cycle the respondent belongs. I chose covariates based on the Andersen & Newman model of health care utilization; they include age, sex, ethnicity, marital status, household education, immigration status and length of stay, household income, language spoken, sense of community belonging, number of physician-diagnosed chronic health conditions, and self-reported health status.

To quantify access, I use a number of dependent variables to capture the many underlying concepts of access to health care. In the main sample, these dependent variables include whether the respondent has a regular medical doctor, reported unmet health care needs in the last twelve months, whether an individual has received a flu shot in the past twelve months, a PAP smear in the past three years or a mammogram in the past two years (noting that certain dependent variables are specific to certain age and gender groups). For each of the above questions, there are also potential reasons for why a respondent would answer no; e.g. the service was not available at the time required. I use these options to identify potential barriers that respondents face in accessing needed health care.

4.1.3 HSAS: additional dependent variables

The Health Services Access Survey (HSAS) has only been completed independently once in 2001 but was later incorporated into the CCHS, beginning in cycle 2.1, as a supplement in sub-sample form. It is related to the CCHS and is a national cross-sectional survey of Canadians collecting data on access to first contact and specialized care, and wait times for health services. HSAS utilizes a sampling strategy similar to that of CCHS but restricts its sample to individuals fifteen years and over, does not cover the three territories and does not sample more than one individual per household as can occur in the CCHS. All other CCHS sample restrictions apply. The sample size of HSAS 1.1 (2001) is limited and meant to provide national estimates only (Statistics Canada, 2001b).

The HSAS data files are comprised of demographic and socioeconomic modules as well as the main Wait Times and Access modules. For my analysis of potential access and access outside of usual clinic hours, I focus on the Access module of the HSAS with only health information, immediate care and routine care services relevant to my study of primary health care. While wait times are certainly important, in general, reporting a wait time is indicative of a service already accessed. Therefore, the potential to access health care can be said to be already achieved. Reality is, of course, not so black and white and it could easily be argued that exceptionally long wait times to see a physician are a barrier to timely access to needed care. However, I analyze wait times as a dimension of temporal barriers in the unmet health care needs and preventive service barriers sections.

4.2 GMF data: key independent variables / exposure

My key independent variables on physician and patient participation in *Groupes de médecine de famille* (GMF) were obtained from François Dubé*, Directeur adjoint de la Direction de l'organisation des services de première ligne intégrés, Ministère de la Santé et des Services Sociaux*.

The Direction collects data on number of total physicians, total primary care general practitioners, GMF-participating general practitioners and GMF-affiliated general practitioners

by Quebec health region and by year. In addition, separately for both vulnerable and general patients, number of total patients enrolled with GMFs and total number enrolled outside GMFs is tracked. I obtained statistics on the Quebec population by health region and year from 2001, 2006 and 2011 census data with in-between years estimated as a linear function of the difference between the census year populations spread over the intervening years.

After implementation of the GMF policy in 2002, participation remained voluntary with the number of GMFs varying both by region and by year. The first GMF participation variable I created measures the share of physicians participating in GMFs – specifically, the number of general practitioners participating in GMFs as a proportion of all primary health care general practitioners in active clinical practice in that health region and year. The second measure is the share of the health region population enrolled in GMFs – that is, the total number of GMF-enrolled patients (general and vulnerable) as a proportion of the total population, by year and health region.

4.2.1 Challenges merging with CCHS / HSAS

Many of the dependent variables from the CCHS and HSAS have important reference dates – e.g. within the past twelve months. Therefore, the reference period is important for making inference between the presence of GMFs and changes in potential access. Data on GMFs gathered, for example, in 2007 would not be relevant to data from the 2007 cycle of the CCHS because the GMF participation measure of 2007 could not have affected the past twelve months of health care access of a CCHS respondent interviewed in January of the same year.

Aside from specific reference periods, it is, in general, highly important when attempting to establish a causal effect that the exposure measure precede all outcome measures. I chose a one-year time lag both due to the presence of reference periods and because GMF participation applies to twelve month intervals and appreciable changes can be seen in GMF data from one year to the next. Complicating matters is that GMF data are not collected over the calendar year as the CCHS data are, but on a fiscal year basis from May 1 to April 30. GMF data labelled 2007 was therefore collected from May 1, 2006 to April 30, 2007. Given the need

for a minimum one year gap and the existence of non-matching collection cycles, merging the GMF and CCHS data has to be approached carefully.

CCHS 2.1 was conducted in 2003 with the look-back period equivalent to the year of 2002. Given that GMF implementation (and data collection) only began, slowly, in November 2002, cycle 2.1 was assigned to be pre-policy data – i.e. respondents are considered not to have been exposed prior to their reported outcomes. Similarly, CCHS 1.1 with reference year of 2000 was also designated as pre-policy. To accommodate the pre-policy years in which no effect of GMFs is possible (for 1.1) or expected (for 2.1), all physician and patient participation variables were given values of zero in CCHS year 2001 and 2003, as there was not yet any participation in GMFs at that time.

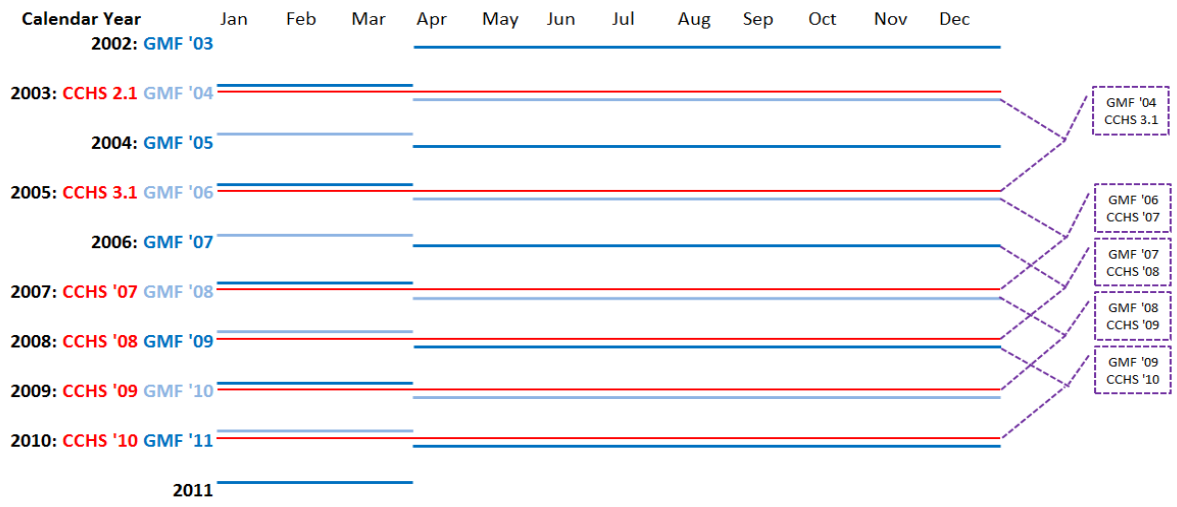

Figure 4.1 Timeline for CCHS (red lines) and GMF (blue lines) data collection. The purple dashed lines on the right illustrate how CCHS and GMF data years are matched.

Matching GMF year with CCHS year was done so that the GMF data collection period occurs *entirely before* CCHS data collection to ensure that the policy exposure occurred before the outcome was measured. Figure 4.1 demonstrates the matching process for CCHS 3.1, 2007, 2008, 2009 and 2010. CCHS 3.1 (2005) was matched with GMF data year 2004 even though the majority of the latter's collection period occurred in 2003. The next option, GMF 2005, overlapped CCHS 3.1 collection by three months and was therefore ineligible for pairing with that CCHS year. In similar fashion, CCHS 2007 was set to be matched with GMF 2006, CCHS 2008 with GMF 2007, CCHS 2009 with GMF 2008, and CCHS 2010 with GMF 2009 (Table 4.1).

The GMF data were merged by year and health region with the final CCHS datasets (main surveys and HSAS sub-sample surveys).

Table 4.1 Matching of GMF data year and CCHS survey year.

Policy status	GMF Year	CCHS Year
Pre	2000	2001
Pre	2002	2003
Post	2004	2005
Post	2006	2007
Post	2007	2008
Post	2008	2009
Post	2009	2010

4.3 Geographic accessibility dataset: additional covariate

The geographic accessibility data categorizes Quebec's census sub-divisions based on the geographic accessibility of health services and was prepared as part of a 2009 report to the INSPQ titled *Entre adaptabilité et fragilité: les conditions d'accès aux services de santé des communautés rurales et éloignées* (Gauthier et al., 2009). Geographic accessibility was based on travel times between census sub-division (CSD), large urban centres and various sources of health services (primary, secondary and tertiary). A continuum from large urban centre to isolated rural community was created with four levels of urban and four levels of rural.

I sought out and expanded this geographic dataset in response to a lack of appropriate geographic variables in the CCHS over time. The geographic CCHS variable identifying a range of urban and rural levels differs substantially in coding and concept between the first four cycles. Combining this variable across cycles is therefore not possible. The simple two-level urban-rural variable is consistently coded between CCHS waves; however, dichotomization of the entirety of Quebec into urban and rural categories would be too crude to be useful in an analysis as there would likely be very little variation within a health region – the unit of analysis in my study. Finally, Gauthier et al. provide compelling arguments for the unsuitability of the CCHS geographic variables for the context of analyzing health care accessibility (Gauthier et al., 2009). They say that CCHS urban and rural categorizations are more reflective of economic and agricultural characteristics of a region and that, due to hierarchical regional health care

organization, the link between availability of services relative to the size of the municipality is not as evident for health services as it might be for economic activity.

4.3.1 Challenges merging with CCHS / HSAS

Gauthier et al. extended the original dataset that used 1996 CSD geographic categories to one using 2001 CSDs. To use the geographic availability data with all seven CCHS cycles, I extended the dataset further to provide geographic categories for 2006 CSDs using a concordance table from Statistics Canada (Statistics Canada, 2008a). There were 100 incorporations and 282 dissolutions between 2001 and 2006 in Quebec. When 2001 CSDs with disparate geographic assignments were merged, the lowest geographic value (that is, the most urban value) was assigned to the newly incorporated 2006 CSD. This strategy was chosen because the most urban CSD was likely to have the greatest population weight among the merging CSDs and because it is the same method used by Gautier et al. to account for changes from 1996 to 2001. Dissolutions – whereby one CSD is dissolved and replaced by one or several new CSDs – were all assigned the category of the former CSD. I merged the resulting dataset by CSD and year with the pooled CCHS datasets.

4.4 Final datasets

The final product of the above four sources of data are two datasets. The first is based on the main CCHS cycles appended together with adjusted probability and bootstrap weights and merged with GMF and geographic health care accessibility data. The second dataset is constructed from the appended HSAS surveys and, again, merged with GMF and geographic health care accessibility data. The first dataset I used to examine potential and realized access as well as barriers to access and the second is used to examine difficulty accessing health care at different times of the day.

5. Variables

In the following chapter I provide an extensive description of variable source, definition, coding, reasons for inclusion, and use in analysis. The chapter is broken down into three sections: dependent variables, independent variables, and covariates. It is not necessary to read this entire chapter to understand the content of this thesis; however, the first section on dependent variables contains important information on the definitions of access being investigated – as well as how these definitions are operationalized – that link back to Chapter 2's discussion and are important for later interpretation of results.

5.1 Dependent

5.1.1 Regular medical doctor

The main variable in my analysis, through which I attempt to capture the potential element of access to primary health care, is whether an individual has a regular medical doctor. This variable arises from the Canadian Community Health Survey (CCHS) question "*Do you have a regular medical doctor?*" which is asked of all respondents in all cycles of the CCHS and can be answered as yes or no. Tania Jenkins employed this question as the dependent variable in her study of socioeconomic inequalities and inequities of potential access to primary care in Quebec (Jenkins, 2009). I choose to use the same variable in my analysis because of its many advantages in capturing the concept of potential access.

Supporting the use of a regular medical doctor as a measure of potential access is the process of health care access proposed by Gauthier et al. The third step in this process, searching for services, is based on the identification of the regular source of the service in question (Gauthier et al., 2009). Without this source, the key step in accessing care is halted or delayed. In a report on access to health care in Quebec, Haggerty et al. (2004) highlight how a lack of primary health care physicians negatively impacts access and that individuals without a primary care physician have poorer rates of access to primary care services (Haggerty et al., 2004). Finally, Lambrew et al. investigated having a regular doctor versus a regular source of care for access to primary care services finding that both are good indicators of (realized) access but that having a regular

doctor was more likely to result in better performance on specific primary health care goals such as the provision of preventive services (Lambrew et al., 1996).

Having potential access to primary health care has been loosely defined here as the ability to obtain the appropriate primary health care services when necessary. I contend that having a regular medical doctor implies the potential to obtain an appointment and gain access to needed care from this physician. Lack of such a regular source could mean a deficiency of personalized, longitudinal care, preventive care, chronic disease management, specialist referral, and continuity and coordination of care.

The use of the term *regular* in the CCHS question implies a longitudinal dimension to the patient-physician history, a key attribute of primary health care (Starfield, 1992). An advantage to *medical* as opposed to *family* doctor may be that it does not required that a regular source of care be within the field of family medicine so long as primary health care services can be received from this provider.

As limitations go, individual understanding of the question may result in interpreting medical doctor as any long-term physician-patient interaction such as an endocrinologist or a gynecologist from whom patients would be unlikely to receive primary health care. Alternatively, this variable may not capture an individual whose regular source of primary care may be a local clinic, though a distinction can be made between the longitudinal quality of primary health care and the transient interaction of first contact services such as emergency departments, walk-in clinics and CLSCs (*Centres local de services communautaires*).

Interestingly, the French version of this question in earlier CCHS cycles (1.1, 2.1 and 3.1) reads *"Avez-vous un médecin de famille?"* which translates to *"Do you have a* family *doctor?"* Note that the French version does not include the term 'regular'; this absence might indicate an assumption of longitudinal care from a family physician. From 2007 on, the French question was reworked to reflect the English wording *"Avez-vous un médecin régulier?"* However, for those first three cycles, the majority of Quebec residents, being French speaking, would be reporting having a family doctor or not. A comparison of responses for this main variable between cycle 3.1 and 2007 indicates no distinct change that might be attributable to the

modification in question wording. The Health Services Access Survey component of certain CCHS sub-samples contains a similar question but explicitly uses the term *regular family doctor* (regular is, again, omitted in the French question).

5.1.2 Regular medical doctor barriers

In all cycles, except CCHS 1.1, respondents are asked from a list for what reasons they feel they have no regular medical doctor. Potential reasons are presented individually and respondents answer yes or no for each. I identify three themes among the five options provided: geographic availability – no one available in the area, none taking new patients, and doctor has left or retired; personal barriers – not tried to contact one; and other – respondents can specify another reason not provided but which is only coded as 'other' in the dataset.

The identified themes allow me to investigate barriers to potential access to a regular medical doctor. Each theme is individually analyzed for the proportion of respondents reporting it so that I can determine the most prevalent barriers to accessing primary care.

5.1.3 Unmet health care needs

Another avenue of investigation into potential access to health care is through the concept of self-perceived unmet health care needs. The full question from the CCHS reads: "*In the past twelve months, was there ever a time when you felt that you needed health care but you didn't receive it?*" and is available in cycles 1.1, 2.1, 3.1, and 2010. Thus, this variable is available in both the GMF pre-policy period (recall CCHS cycles 1.1 and 2.1 are considered pre-policy data) and the post-policy period.

There is widespread use of the concept of unmet needs as a means of evaluating quality of care, patient satisfaction and access to needed care. In Canada, unmet health care needs is mainly utilized in studies of health care access such as Wu et al. and Gauthier et al. 2009 where the latter studied access to health care services in the context of rural Quebec.

In terms of potential access, if care is needed but cannot be obtained, then the potential to receive it is also likely missing. An exception could be an individual who decides not to seek

care; alternatively, that individual may feel they lack the necessary information to seek care or the ability to obtain it. Here I presume that respondents indicating unmet needs desire the needed care and have either not sought out care or have sought out needed care but were unsuccessful in achieving it. Both circumstances point to a deficiency of potential in acquiring care and are likely due either to a real insufficiency in availability or due to a lack of appropriate information on obtaining care. Unmet needs can therefore be used as another facet – the ability to seek care – of potential access to health care.

Unfortunately, the CCHS question does not inquire explicitly about unmet primary health care needs; a respondent might be referring to any type of care. It can be argued that most health services are mediated through primary health care – immediate care for minor health problems, general health promotion, chronic disease monitoring, and specialist referrals. However, an individual may receive a referral but might then be unable to obtain an appointment in a reasonable amount of time. Much depends on the respondent's subjective understanding of health care need. Another limitation is that, while individuals answering yes to the question of unmet needs represent those having not sought care or having failed in their attempt to seek care, those answering no do not necessarily represent the compliment of having been successful. The latter are in fact a combination of those seeking and succeeding and those having no need for health care within that reference period.

5.1.4 Unmet health care barriers

As with the regular medical doctor question, the CCHS further enquires after the reasons behind the presence of unmet needs. An extensive list of possible reasons is provided to each respondent indicating unmet needs in the last twelve months. From this list, I identify themes, using each as a dependent variable to identify the most prevalent reported barriers to accessing needed care. The fives themes are: geographic availability of health care – service unavailable in area, transportation problems; temporal barriers – wait times, service not availability at time required; personal barriers – chose not to seek care, did not believe it would help, afraid, too busy; financial – perceived or actual costs; and other barriers – other category and remaining reasons that do not reflect any of the four previous themes. An example of a

reason placed in the other category would be that a doctor did not think care was necessary. In such a case, some amount of health care has been accessed regardless of the disagreement between patient and physician in terms of need. Reducing the long list of reasons into five themes was necessary to make analysis more manageable and to eliminate unnecessary analyses of variables of similar concepts.

As discussed in the Data chapter, content can differ between CCHS cycles. While all cycles with the unmet needs question also include reasons for why an individual might perceive their needs unmet, the list of reasons can differ between cycles. Many categories appear consistently in all or many cases and some appear sporadically or only once. The five themes are chosen in conjunction with the literature on dimensions of access (Gulliford et al., 2002; Penchansky & Thomas, 1981; Torgerson et al., 2006) and on the categories of data common to all cycles. In the interest of pooling and temporal analysis, if a relevant reason is made available in one cycle only, then it is likely coded into the other category or into one of the existing themes should its underlying concepts be amenable. The complete set of common reasons can be seen in Appendix A Table A–4. It is worth noting, of course, that combining categories also has the potential to obscure real differences.

5.1.5 Preventive care – flu shot, Pap test, mammogram

One of the characteristics of primary health care is an emphasis on preventive care. An annual physical check-up would be an obvious indicator but checking blood pressure, tracking weight changes, tobacco counselling, receiving a seasonal influenza vaccination, ensuring that women of certain age categories undergo Pap tests and/or mammograms at appropriate intervals are also important markers of the quality of the health care system. I examine these last three health services in an effort to determine if the spread of GMF participation has had an impact on the provision of preventive care. This sub-analysis focuses on realized access since a change in the provision of specific services is conditional on accessing care.

A primary health care physician may not directly provide these three preventive care services; however, compliance with recommended guidelines on receipt of specific services is shown to increase through proper management of patient cases and through patient-physician

interaction and communication (Bindman, Grumbach, Osmond, Vranizan, & Stewart, 1996; Blewett, Johnson, Lee, & Scal, 2008; Flocke, Strange, & Zyzanski, 1998; Pandhi et al., 2011). As such, I investigate how increased GMF participation may have impacted the recommended uptake of health services.

The flu shot module is available in all cycles of the CCHS except cycle 1.1 and I use it to analyze the proportion of individuals receiving a seasonal flu shot within the past year. In general, it is recommended that all individuals be vaccinated prior to each flu season. Emphasis and priority in vaccine distribution is placed on seniors, individuals in poor health, young children and pregnant women (PHAC, 2013; Santé et Services sociaux Québec, 2013). All CCHS respondents answer the questions: *"Have you ever had a seasonal flu shot?"* and (if yes) *"When did you have your last seasonal flu shot?"* Individuals answering no to the first question and greater than one year on the second are combined, while those indicating less than one year since last flu vaccination remain their own category.

Both the Pap smear optional module, asked of women 18 years and over, and the mammogram optional module, asked of women 35 years and over, have data available for Quebec residents in cycles 1.1, 2.1, 3.1 and 2008. In Canada, mammograms are recommended every two years for women over age 50 and Pap tests are recommended every two to three years for women over 21 (Canadian Task Force on Preventive Health Care, 2013). Men and non-eligible women (due to age) are coded into a separate 'not applicable' category which is not included in the regression analysis. In similar fashion to the flu shot module, respondents of the Pap test and mammogram modules are asked if they have ever received the service and then when the last time the service was received and adherence to guidelines is determined accordingly.

5.1.6 Preventive care barriers

As with the regular medical doctor and unmet health care needs questions, the above three dependent variables also have follow-up questions asking respondents why they have not received a service within its given reference period (one year for flu shot, two years for mammogram and three years for Pap test). Similar reasons to those for unmet needs are provided; some notable exceptions are having had a hysterectomy for Pap test and having had

a mastectomy for mammogram. A woman indicating either of the latter two circumstances is placed in the 'not applicable' category along with men and other women not of the appropriate age. The barrier themes are the same as those derived for unmet needs: geographic availability, temporal barriers, personal barriers, financial and other.

The flu shot and Pap test barrier questions are asked of all eligible individuals. By contrast, women 50 to 69 years are asked why they have not had a mammogram within the past two years. This age restriction on the universe of respondents is likely meant to reflect the age at which recommended mammogram screening is meant to begin.

5.1.7 Difficulty receiving health care services – health information, immediate care and routine care

One of the main goals behind primary health care reform being implemented across Canada has been to reduce emergency department usage for non-emergency care (Romanow, 2002). Improving the availability of first contact services and ensuring appropriate case management – e.g. for chronic diseases – are important objectives of team-based models meant to reduce pressure on emergency departments. GMF initiatives in this line include requiring access to a GMF physician outside usual clinic hours, drop-in services without an appointment (though usually as a member of the GMF), and ensuring provision of care in the absence of the patient's main physician through patient file sharing.

From the Health Services Access Survey, there are a number of questions addressing access to a variety of services including non-emergency surgery, diagnostic tests, regular care and first contact services. From among these themes, I chose the concept of difficulty in obtaining the services of health information, and immediate care for minor health problems as indicators of first contact care access; I use difficulty receiving routine or on-going care to reflect access to standard care and appropriate case management. Difficulty receiving a health service implies that an individual has sought out the service and has encountered barriers but it does not necessitate that the desired service was never accessed. A complete lack of potential access to health services cannot, therefore, be suggested; however, reduced or impeded potential access can be inferred from these difficulties.

The sequence of questions for each of the above three services is the same and each dependent variable is constructed in similar fashion. For health information, the relevant questions are *"In the past twelve months, have you required health information or advice for yourself or a family member?"* and (if yes) *"In the past twelve months, did you ever experience any difficulties in getting the health information or advice you needed for you or a family member?"* Respondents answering no to the first question are placed in a non-applicable category that is not included in the regression analysis and that does not count toward the missing category of item non-response. Those answering yes or no to experiencing difficulties become their own categories. The same process is repeated for experiencing difficulty obtaining immediate care for minor health problems and difficulty obtaining routine or on-going care.

5.1.8 Difficulty receiving health care – Regular hours, evenings and weekends, nights

For each respondent reporting an experience of difficulty in obtaining one of the above three first contact or regular health care services, a further series of questions follows regarding the time of day the difficulty was experienced. These times include regular office hours, evenings and weekends, or the middle of the night. *"Did you experience difficulty getting health information or advice during regular office hours (i.e. 9:00 am to 5:00 pm Mon-Fri)?"* and *"Did you experience difficulty getting…during evenings and weekends (i.e. 5:00 to 9:00 pm Mon-Fri or 9:00 am to 5:00 pm Sat-Sun"* and *"Did you experience difficulty getting…during the middle of the night?"* Respondents not requiring the health information or not experiencing difficulties in receiving it are coded as 'not applicable' for this variable.

5.2 Independent

Generally, a difference-in-difference (DD) analysis uses three main independent terms: a time variable to indicate data collected before and after a policy implementation, a group variable to distinguish treatment – i.e. where policy implementation occurs – and control groups and finally an interaction of time and group. All of the above are dichotomous variables and a value of 1 is assigned to the after period and to treatment group. The effect of treatment after policy

implementation is therefore given by the estimated coefficient on the interaction term (see section 6.2 for more on DD design).

GMF implementation began in 2002 but was then and remains now entirely voluntary so that GMFs emerged at different rates in different regions across Quebec. Therefore, no sharp demarcation in time or space from pre-policy to complete policy exposure is available. Instead, I modify the DD design to take into account the changing continuous GMF exposure over time and between health regions.

5.2.1 Year

The time term in my modified DD model becomes a series of indicator variables representing the calendar year. Which years are available is determined by the year in which the relevant CCHS data is collected. GMF data are also recorded by year; however, the GMF collection period actually covers the fiscal year. For details on how GMF and CCHS years are matched see the Data chapter section 4.2.1.

5.2.2 Health region

Similarly, the dichotomous group term is replaced by a series of indicator variables for region comprised of the health regions of Quebec. Health region was chosen as the unit of analysis because of the hierarchical organization of health care services within a health region and because GMF participation data are collected at the health region level.

In Quebec, there are eighteen health regions (called *régions sociosanitaires* or RSS) but only fifteen are used in my analysis. Two health regions, Nunavik and Terre-Cries-de-la-Baie-James are not surveyed in the CCHS because they are too sparsely populated and too remote to be reached. RSS 10, Nord du Quebec, covers roughly half of the provincial area of Quebec but contains just over five percent of the population. Data is available in the CCHS for Nord du Quebec; however, I consider it sufficiently different from other Quebec health regions to make comparisons inappropriate. For use in my regression analyses, the reference region was chosen to be RSS 16 Montérégie. This region was chosen because it was quite average in its pre-policy characteristics including baseline percentage of resident with a regular medical doctor.

5.2.3 GMF participation

As mentioned above, the coefficient on the interaction term in a standard DD design represents the effect of the policy after implementation in a region where the policy was implemented. In place of the interaction term, I utilize a continuous variable measuring GMF participation which varies by region and year in the same way the interaction term would. Region-level participation is used to approximate exposure to the impacts of GMF policy implementation.

GMF participation is derived from variables available in the GMF dataset. I create two GMF participation measures. The first represents the share of physicians participating in a GMF within a region and year. It is calculated by dividing the number of primary health care general practitioners (GPs) practicing in GMFs by the total number of primary health care GPs in a health region and year. The second measure represents the proportion of the population enrolled as patients (clients) in GMFs and is derived by dividing the total number of patients (general and vulnerable) enrolled in GMFs by the total population in a region and year.

5.3 Covariates

In a difference-in-difference analysis, covariates are used to increase precision of the effect estimates by allowing individual characteristics to explain some of the variation in the dependent variables – having a regular medical doctor, unmet health care needs, obtaining various health services, etc. I chose my covariates based on the Andersen & Newman model of health care utilization (R. Andersen & Newman, 1973). This model identifies three types of characteristics – predisposing, enabling and need – that impact health care utilization and health seeking behaviours. Predisposing characteristics of an individual are present before contracting a disease or requiring health care and influence the predisposition of individuals to use health services. Enabling characteristics represent resources that can hinder or enable individuals in their use of health care services whether personal or health system related. Finally, individual need, evaluated or self-perceived, can affect the likelihood of accessing care.

5.3.1 Predisposing

Among the predisposing covariates investigated in this study are age, sex, ethnicity, marital status, and highest level of education in the household. All of the predisposing covariates are found within the CCHS.

In this analysis, age is measured continuously in years with a lower limit of 18 years (restricted to adults to eliminate reporting of pediatricians in my main potential access variable: having a regular medical doctor). Women are more likely than men to seek health care and are more likely to have a regular physician (R. Andersen & Aday, 1978; Wellstood et al., 2006); the sex variable is dichotomous with levels of male and female. Married and common-law individuals have been shown to use more health care than separated, divorced or single individuals (Aday & Andersen, 1974); the CCHS marital status variable has six levels: married, common-law, widowed, separated, divorced, and single, never married.

Ethnicity can have a large impact on the likelihood of an individual seeking care. Cultural factors may limit trust in Western medicine, gender issues may restrict ability to seek care, and fear of racism can also deter individuals from seeking needed health services (Nabi, 2002; Wu et al., 2005). Because of Quebec's predominantly white-identifying society, the ethnicity covariate was reduced to only two levels of white and ethnic minority.

Finally, education is a well-known factor in the utilization of health care, health/lifestyle behaviours, and health care seeking behaviours (R. Andersen et al., 1983). Highest education of the household was chosen as the individual with the highest education is expected to influence household members – partner, child, parent, etc. – in their health choices. The education categorizations are based on the unique education system in Quebec and modify a ten level household education variable of the CCHS. These levels are: less than high school, high school diploma, some post-secondary education, trade school/CEGEP[5] diploma/university certificate,

[5] CEGEP stands for *Collège d'enseignement général et professionnel*, in English known as General and Vocational College. CEGEP can be attended by high school graduates where they may study in two-year pre-university programs (mandatory for application to university for Quebec high school graduates) or three-year vocational programs.

and university degree or higher. Jenkins used this categorization in her work on socio-economic disparities in potential access to primary care in Quebec (Jenkins, 2009).

5.3.2 Enabling

The enabling factors examined are immigrant status and length of stay in Canada, language proficiency, sense of community belonging, household income adequacy, and urban-rural classification. The first four covariates are found within the CCHS while the urban-rural classification is taken from a separate dataset that assigns one of eight urban/rural levels to an individual's census sub-division (CSD).

Level of acculturation for an immigrant has been identified as strongly influencing health care usage and seeking behaviours. Often immigrant status is used alone in general population studies (Marshall, 2011; Ryan, Stewart, Campbell, Koval, & Thind, 2011). In studies targeting immigrants, length of stay or proportion of life spent in Canada is also included (Lebrun, 2012; Wu et al., 2005). McCusker et al. combined these two concepts in their 2010 study on emergency department usage in Quebec using CCHS data (McCusker et al., 2010). I use their categories in my DD analysis: born in Canada, five years or fewer in Canada, six to ten years in Canada, and ten or more years in Canada.

Language proficiency, like length of stay, can also be seen as an acculturation factor and important for enabling communication between an individual and a health professional (Lebrun, 2012; Ng, Pottie, & Spitzer, 2011; Wu et al., 2005). However, while the majority of individuals born in Quebec speak French as their mother tongue, an important minority of English-speaking individuals also exist, mainly in the metropolitan area in and around Montreal. The two official languages of Canada are English and French; in the province of Quebec, only French is considered an official language. Therefore, language proficiency may impact the ability to communicate effectively for any individual – immigrant or not – without command of the French language. I use the CCHS question for languages in which the respondent can converse and reduce it two four levels: French, not English; English, not French; French and English; neither French, nor English.

Gauthier et al. found that the majority of individuals residing in Quebec access primary health care within their local communities (Gauthier et al., 2009). An individual's sense of belonging to their local community may therefore impact their knowledge of the availability and location of health care services, doctor's offices, or drop-in clinics. Sense of community belonging is a variable in the CCHS and has been applied in studies of health care utilization (Lebrun, 2012; Wu et al., 2005). The four levels of community belonging are: very strong, somewhat strong, somewhat weak and very weak.

The Canada Health Act of 1984 specifies the removal of financial barriers in accessing health services which has largely come to fruition. Health services covered by the provincial health insurance plan are provided at no cost for that province's residents. However, various versions of income or income adequacy variables are applied in virtually every study on health care utilization in Canada. Income is important in accessing health care in the sense that income reflects an individual's socioeconomic position in society. Social inequities in potential access to primary care in Quebec have been demonstrated by Jenkins (2009) indicating the importance of including an income covariate. I constructed an income adequacy variable based on household income and number of persons in the household. I followed the definition and coding of income adequacy levels of the derived income adequacy variable in CCHS 2.1: low, lower-middle, middle, middle-high, and high (for exact category definitions of income level and number of persons see Appendix A Table A–2).

Differences in access to care in Canada depending on location of residence have long been established (Da Silva & Pineault, 2012; Gauthier et al., 2009; Sibley & Weiner, 2011). Rural and remote or isolated areas have often found a serious deficiency in physicians, nurses, and other health professionals. However, Montreal, the largest city in Quebec, and its surrounding areas have also reported a marked shortage of practicing general physicians for many years. Numerous studies use the dichotomy of urban and rural to account for the difference in access to care. Such a simple distinction would likely result in very little variation within a health region, the unit of analysis in my study. The CCHS provides a multi-level urban-rural variable; however, this variable is inconsistent across cycles and cannot be combined. Instead, I adopt

the geographic variable that Gauthier et al. developed based on residents' census sub-divisions and travel times to primary, secondary and tertiary forms of care. The eight categories of geographic location are: large centers, sub-specialized centers, peripheral specialized centers, regional specialized centers, peripheral rural zones, intermediate rural zone, remote rural zones and isolated rural zones (Gauthier et al., 2009). Specific level definitions with travel times and types of care are available in Appendix A Table A–3.

5.3.3 Health need

Health care need factors examined in this analysis are number of physician-diagnosed chronic conditions for evaluated need and self-reported health status for perceived need. Physician-diagnosed chronic conditions may require treatment from a specialist or a general physician but are generally associated with some form of monitoring. Having one or more chronic conditions is therefore associated with having a regular source of care and is a covariate often used in utilization studies (Allin, Grignon, & Le Grand, 2010; McCusker et al., 2010; Ryan et al., 2011; Sibley, Moineddin, Agha, & Glazier, 2010). CCHS respondents are read an extensive list of conditions and for each are asked if they have been diagnosed. The list of conditions varies between cycles with some appearing in all years and others introduced for one or two only. The chronic conditions that I consider are the common set of conditions across all cycles. For each respondent the number of conditions from this common set is totalled and the individual is then categorized into one of four levels: none, one, two, and three or more chronic conditions. A list of the chronic conditions from the common set can be seen in Appendix A Table A–4.

The self-perceived component of need is also important when examining access to health care (R. Andersen & Newman, 1973). Self-perceived health status has been shown to be a good predictor of overall health and strongly associated with health seeking behaviours and – by proxy for actual level of health – having a regular physician. I use the CCHS self-reported health status, a five level variable with levels of excellent, very good, good, fair, and poor.

6. Methods

6.1 Causal inference

In epidemiologic studies, the use of causal inference in analysis implies the ability to intervene on the independent variables to cause a desired change. Inference cannot be made on a variable that cannot be manipulated. For example, the type of house an individual lives in can easily be 'set' in the counterfactual world – that is, where the same individuals in the same place and during the same time period experience, counter to fact, an alternate exposure – from detached single family home to apartment. However, some immutable properties of individuals exist such that 'setting' them to the counterfactual value is impossible. Such characteristics include sex and race or ethnicity. Causal inference in policy analysis is fairly intuitive in that a policy can be plausibly set on or off.

We would like to measure two states of the world, exposed and unexposed: Y_{0i}, the outcome for individual *i* under no treatment and Y_{1i}, the outcome under treatment. The difference of $Y_{1i} - Y_{0i}$ gives the treatment effect for individual *i* and the expectation of this difference, $E[Y_{1i} - Y_{0i}]$, for some sample gives the average treatment effect (ATE) of the exposure on the sample. With a representative sample of a population, the population ATE can be calculated.

Since individuals only experience one state of the world, exposed or unexposed, measuring the outcome in the counterfactual state, that which does not occur for a given individual, is impossible. Two ways of estimating the treatment effect can be used. We often use substitute comparison – or control – groups to estimate Y_{0i} where the appropriateness of the control group as a 'substitute' for the exposed group influences the credibility of reported effect estimates. In other cases, we might compare the effect in one group measured before and after treatment. Importantly, however, the theoretical counterfactual treatment group experiences the treatment and resulting outcome concurrently with the true treatment group. Therefore, a before-after comparison cannot account for possible changes that would have occurred over time regardless of the treatment status.

6.2 Difference-in-differences

The difference-in-difference (DD) analysis design is one that is explicitly intended for estimating a causal effect and incorporates both the control-treatment group and before-after components. The DD model has largely been employed in economic research but has been gaining traction in other disciplines, notably in that of health services research where this method is particularly useful in the area of health policy analysis. A governmental policy is generally considered to impact all members of some population. When analyzing the effects of a policy implementation, there is necessarily a before and after period; however, as discussed above, how can we be sure that any determined effects are solely due to the policy and not to change that would have happened over time in that population even in the absence of that policy? The DD method addresses this issue by adding an exposed vs. unexposed group component (often this is determined by regional areas) to the analysis. The first difference is in time – before and after the policy implementation; the second difference is by group – a treatment group where the policy has taken effect and a control group – i.e. a substitute counterfactual – for whom no such policy exists. The comparison group should be one that is similar enough to the experimental group in every way that the two could be considered exchangeable except that the policy is present in one and absent in another. A parallel can be easily drawn between this quasi-experimental design and randomized control trials where the key difference is randomization in exposure.

The DD model is sometimes considered a double fixed effects model where the fixed effects for time control for common time trends in the outcome and the fixed effects for group control for time invariant differences between the treatment and control groups. This control is necessary because the treatment is not randomized. Importantly, by controlling for (time-invariant) observed and unobserved confounders, the DD model attempts to estimate the causal impact of a policy implementation on the chosen outcome of interest – i.e. an estimate of the average treatment effect of the policy implementation.

The simplest DD design can be shown in the 2x2 table below where the outcome is measured before and after implementation in both the control and treatment groups. The difference in

outcome between the treatment group and control group after implementation is differenced from the difference between the two groups in the before period.

Table 6.1 Simple DD design with the outcome measured in the treatment and control groups before and after policy implementation.

	Treatment	Control	Difference
After	Y_{ta}	Y_{ca}	$Y_{ta} - Y_{ca}$
Before	Y_{tb}	Y_{cb}	$Y_{tb} - Y_{cb}$
Difference	$Y_{ta} - Y_{tb}$	$Y_{ca} - Y_{cb}$	$(Y_{ta} - Y_{ca}) - (Y_{tb} - Y_{cb})$

A regression version of the 2x2 table is shown in equation [1] below. The Time and Group variables are both dichotomous where Time *t*=0 represents the before policy implementation period and *t*=1 represents time after implementation; similarly Group *g*=0 is the group unaffected by the policy and *g*=1 is the treatment group subject to the policy. Y_{itg} is the chosen outcome for individual *i* at time *t* and in group *g*, β_{tg} represents the joint effect of being in the treatment group post implementation and ε_{itg} is the error term for individual *i* in time *t* and group *g*.

$$[1] \quad Y_{itg} = \beta_0 + \beta_t Time_t + \beta_g Group_g + \beta_{tg} Time_t * Group_g + \varepsilon_{itg}$$

$$\hat{\beta}_0 = \left(\hat{E}\left[Y_{itg} | T = 0, G = 0\right]\right)$$

$$\hat{\beta}_t = \left(\hat{E}\left[Y_{itg} | T = 1, G = 0\right] - \hat{E}\left[Y_{tg} | T = 0, G = 0\right]\right)$$

$$\hat{\beta}_g = \left(\hat{E}\left[Y_{itg} | T = 0, G = 1\right] - \hat{E}\left[Y_{tg} | T = 0, G = 0\right]\right)$$

$$\hat{\beta}_{tg} = \left(\hat{E}\left[Y_{itg} | T = 1, G = 1\right] - \hat{E}\left[Y_{itg} | T = 0, G = 1\right]\right) - \left(\hat{E}\left[Y_{itg} | T = 1, G = 0\right] - \hat{E}\left[Y_{itg} | T = 0, G = 0\right]\right)$$

The DD regression also has the power to analyze data more complicated than a simple pre-post and two-group comparison. It is often desirable to have multiple years before and after the policy takes effect in order to more effectively examine time trends. Having several comparison groups can be informative when an ideal single control group is not available as choice of comparison group can impact the direction and magnitude of the estimated effects. These added variations can be taken into account by extra variables for year and regions fixed effects,

for example. Often demographic and control variables are then included to account for individual-level observable differences between the time periods and groups and to reduced unexplained variance in the effect estimates. Equation [2] gives the structure of this more complex DD regression model.

$$[2] \quad Y_{iyr} = \beta_0 + \beta_{yr} PolicyExp_{yr} + \beta_y Year_y + \beta_r Region_r + \beta_x X_{iyr} + \varepsilon_{iyr}$$

Here I have replaced the $Time_t$ and $Group_g$ main effects terms with $Year_y$ and $Region_r$ main effects; the interaction term from equation [1] is replaced with a single term $PolicyExp_{yr}$ to make reading the model easier. $PolicyExp_{yr}$ is an indicator turned on or off as a function of year (a year before or after implementation) and region (whether the region belongs to the exposed or unexposed group). The terms $Year_y$ and $Region_r$ represent the year and region fixed effects, respectively, each with multiple levels; and X_{iyr} is a vector of individual and area-level covariates that can vary by year, region and by individual.

6.2.1 Modifications of the DD model

Some policy implementations may differentially impact different groups of people, a scenario in which the policy cannot be reduced to an on-off term in a regression. Accordingly, some researchers have modified the DD design to allow a policy's impact to have varying treatment intensities by group and over time. For example, Card 1992 analyzed the impact of the introduction of a federal minimum wage on wages and employment among teenagers (Angrist & Pischke, 2009). The impact of the new federal minimum in each state depends on the state minimum wage just prior to implementation. Card used the fraction of teenagers likely to be affected by the federal minimum in each state (FA_s) and interacted this term with a dummy variable D_t indicating the year for which the policy was implemented; a before-after dummy was also included, $Time_t$, along with state fixed effects, $State_s$.

$$[3] \quad Y_{its} = \beta_0 + \beta_t Time_t + \beta_s State_s + \beta_{ts}(FA_s * D_t) + \varepsilon_{its}$$

The average treatment effect could be calculated because Card used only two periods in his analysis which allowed him to report the impact of FA_s on the *change* in average teen wage/employment in state *s* using a first differences equation.

Another example comes from Duflo investigating the impact of a large state sponsored program to build elementary schools in Indonesia over a short period of time on educational attainment and earnings (Duflo, 2001). In Part I of her study, Duflo used a non-regression DD design to estimate the causal impact of the program using date of birth and region of birth to jointly determine individual exposure. Individuals born in 1962 and before would have, generally, left elementary school by 1974 when the first round of school construction was completed. Children born in subsequent years would have had an increasing exposure to the new schools as a function of their date of birth. The number of schools built per region was based on the region's rate of school age children not enrolled in school in 1972 and added a second layer of variation to the treatment intensity measure. To validate her results, Duflo turned to a regression based analysis that incorporated region of birth fixed effects ($Region_r$), birth year fixed effects ($Year_t$), a term for program intensity by region (P_r), a vector of region-specific covariates (X_r) and a dummy indicator for a young or older cohort (T_i). Equation [4] below is based on equation 1 of Duflo's study where Y_{itr} represents the educational level of individual *i* born in year *t*, and region *r*.

$$[4] \quad Y_{itr} = \beta_0 + \beta_1 Year_t + \beta_2 Region_r + \beta_3 (P_r * T_i) + \beta_4 (X_r * T_i) + \varepsilon_{itr}$$

Duflo used the latter regression model with various age group subsamples for the 'young' and 'old' cohort categories as well as other modifications to the regression equation to further test some of the DD assumptions and to estimate the impact of the new schools on educational attainment and earnings.

6.2.2 Difference-in-differences model assumptions and testing

There are three important assumptions for the DD model: exchangeability of the treatment and control groups, exogeneity of the policy implementation; and common outcome trends in the absence of treatment.

When comparing an outcome across a treatment and control group, naturally exchangeability of the two groups is necessary to estimate a causal effect. To establish exchangeability, we compare characteristics of the control and treatment groups before the policy is implemented.

An absence of important dissimilarities in group geographic, demographic, social and economic characteristics is generally used as support for an appropriate choice of control. However, it is important to recall that any observed and unobserved fixed differences – i.e. time-invariant differences – between groups are accounted for by the group fixed effects term in the DD design. In addition, examining the outcome over time in the control and treatment groups should produce parallel trends in the pre-implementation period (Figure 6.2) that indicate fixed differences over time prior to any treatment exposure.

A more stringent assumption of the DD model is exogeneity of the policy implementation; specifically, that the implementation of the policy is exogenous, conditional on time and group fixed effects. The policy should not be correlated with time-varying differences found in one group and not in the other. Consider in- or out-migration of specific subpopulations to or from the treatment group in response to a policy implementation. If these changes in group structure also impact the outcome of interest, then the effect of the policy cannot be isolated using the basic DD design. In investigating the exogeneity of the policy implementation, we can examine the characteristics of the control and treatment groups that should not be affected by the policy and compare before and after policy implementation. In effect, the before/after differences for the treatment group should be negligibly different from the before/after differences of the control group.

Alternatively, we can examine exogeneity through the lens of reverse causality. If the policy is implemented in regions where the outcome of interest is at an undesired level or state, then implementation of the policy in those regions will not be considered exogenous to regional characteristics. In such a situation where previous outcomes influence exposure, interpretation of effect estimates of the exposure from the DD model as causal may be problematic.

Finally, the common outcome trends assumption is essential for maintaining the validity of the DD model. This assumption states that, in a counterfactual reality where the policy is introduced in *neither* group, the outcome trends for the treatment and control groups from the pre-policy period will continue. An important corollary to the common trends assumption is that any change in the outcome for the treatment group after implementation relative to the

control group after implementation is assumed to represent the treatment effect of the policy implementation (Figure 6.1) – i.e. that the policy implementation is the only cause of change in the outcome.

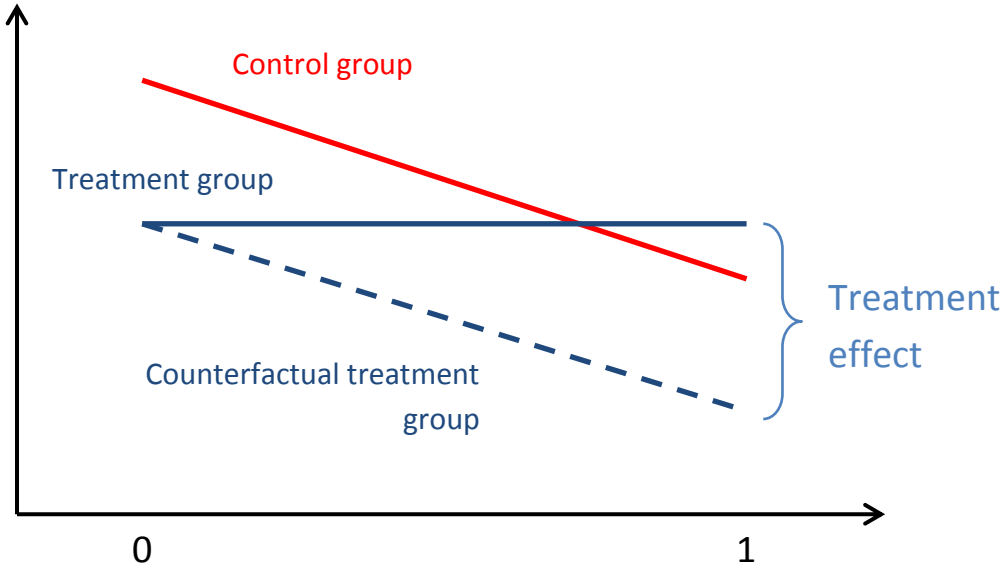

Figure 6.1 Diagram of common outcome trends assumption showing the assumed counterfactual trend in the absence of the policy. The true treatment effect is the difference at Time 1 between the treatment group and the counterfactual treatment group. Adapted from Angrist et al. 2009.

While it is impossible to ever know if the outcome trends would have remained similar over time in the absence of the policy, we can examine these trends in the pre-policy period. A simple test for common trends is possible when multiple time points of collected data (minimum two) are available prior to policy implementation. We want to see that the outcome trends for the control and treatment groups follow roughly similar trajectories in the pre-policy period. Note that the outcomes do not have to be equal, only that the difference in the outcome between the two groups must be fairly constant; in this manner, the group fixed effects term can control for the pre-period outcome differences.

An ideal fictional example in Figure 6.2 demonstrates parallel outcome trends in the pre-implementation period; following a policy implementation, the treatment group outcome trend changes trajectory in response to the policy while the control group outcome trend remains constant. Additionally, a substantive investigation into the existence of other policies or

programs that may influence our outcome of interest in either the treatment or control groups is important for supporting the assumption that the policy implementation is the only cause of change in the outcome.

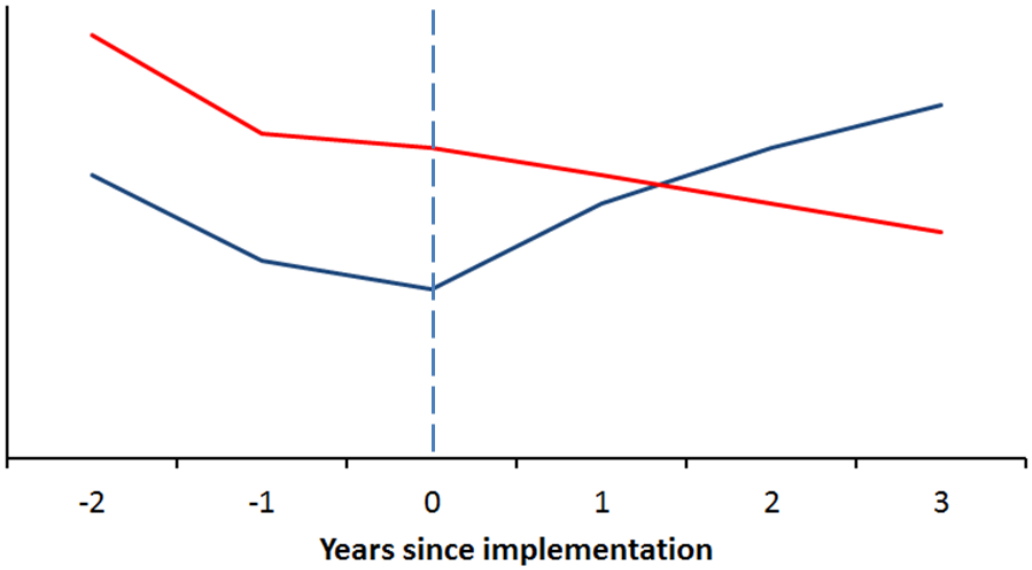

Figure 6.2 Fictional example of outcome trends for a treatment group (blue) and a control group (red) before and after policy implementation which is marked by the vertical dashed line.

To test the overall validity of the model for the purpose of a particular analysis, we conduct placebo tests using the same dataset as the main analysis, expecting to find a non-significant impact of policy implementation. If a significant treatment effect of the policy is found using the placebo test, we then worry that our model may also detect significant effects on our outcome of interest where no actual effects exist. There are a few ways in which a placebo test can be structured. The simplest is to select an outcome variable we substantively believe should not be affected by the implementation of the policy. A significant effect of the policy on the placebo outcome would indicate that other significant effects found using this model may not represent true causal impacts of the policy. Alternatively, we can retain our outcome of interest but change the date of policy of implementation. Since the DD model finds the effect of being in the post-implementation period, changing the pre/post cutoff should generate a non-significant result. Lastly, if a policy is expected to have no effect in a specific sub-group of the population, we can restrict the analysis to these subjects, expecting a non-significant effect.

6.2.3 Limitations of the DD model and possible solutions

The most important limitation of the basic DD model is its inability to control for possible time-varying confounding in the exposure-outcome relationship. Some options are available if time-varying confounding is uncovered or suspected. The inclusion of individual or area-level covariates in the DD model can adjust for observed time-varying confounding. For example, state of origin can be used to control for migration of individuals to states with more generous public assistance programs when examining the latter's impact on labour supply (Angrist & Pischke, 2009). However, covariate adjustment cannot control for unobserved time-varying confounding. Another potential solution involves adding group-specific time trends to the DD regression model that control for differences in the treatment and control groups that can vary over time. As the group-specific time trend is essentially an interaction between group and continuous linear time, we would need at least three time periods in our data to estimate its effects (Angrist & Pischke, 2009). A further possibility is to add a third difference to the effect estimation procedure in what is called a difference-in-difference-in-differences (DDD) model. For example, if a policy differentially impacts specific groups, such as Medicaid eligibility in the 1960s and 1970s for single women with children but not single women without children, then the addition of a variable valued at 1 for individuals belonging to that group and valued at 0 otherwise will control for that difference. In this case, a potential confounder would need to vary at the level of the triple interaction (sex*marital status*children), as confounders that act at the levels of the main effects or two-way interactions will be controlled (Strumpf, 2011).

Challenges arise when considering how to treat variance estimation for the DD model. When using repeated aggregated measures ordinary least squares methods will underestimate standard errors. At the very least, clustering of standard errors at the group/region level is required (Donald & Lang, 2007), just as clustering on subject is generally used when analyzing panel data. However, Bertrand et al. believe that clustering is insufficient for producing valid standard errors – i.e. SEs will still be underestimated, often resulting in spurious significant results – when the outcome of interest is likely to be serially correlated over time (Bertrand, Duflo, & Mullainathan, 2004). They believe that a large majority of outcomes investigated using

the DD model in economic and health services research fields suffer from serial correlation. For example, a state experiencing economic shocks in one period is likely to continue experiencing these shocks in the subsequent time period.

6.3 Adapting the DD framework for my analysis

I adapted my analysis of the impact of GMF implementation on access to primary health care in Quebec from Duflo's use of a continuous measure in capturing policy treatment effects. Because the implementation of GMFs was voluntary, there is variation in the uptake of this form of primary health care delivery by health region and over time. Due to this variation, there is no distinct period in which a population is considered completely exposed. As well, there is no ideal unexposed control group after implementation because all health regions of Quebec have some level of participation within the first years after the GMF policy was introduced. A DD model with a treatment and control group is therefore not appropriate. In place of the time-group interaction term of the DD model, I use a continuous variable representing the 'participation' of patients and physicians in GMFs that varies by year and health region to capture area-level exposure to the GMF model (see section 5.2.3 for a definition). While we expect that individual-level variation in GMF participation would not be safely considered exogenous (Coyle, 2011), participation rates at the health region level are more plausibly unconfounded with individual-level outcomes. That is to say, I estimate how the outcome of having a regular medical doctor (and other access outcomes) changes as the level of participation in GMFs changes by health region and year. I include year fixed effects to control for common time trends in access to primary care across all the health regions of Quebec and region fixed effects to control for fixed differences between health regions. Individual level covariates are included to adjust for observable time-varying differences between health regions and to improve the precision of the effect estimates.

$$[5] \quad Y_{itr} = \beta_0 + \beta_t Year_t + \beta_r Region_r + \beta_{tr} GMFpar_{tr} + \beta_x X_{itr} + \varepsilon_{itr}$$

In regression equation [5], $GMFpar_{tr}$ is the GMF participation variable and β_{tr} gives the population average treatment effect for a one percentage point increase in GMF participation on reported access to primary health care.

Above I have shown a linear regression of an outcome Y_{itr}; however, all my reported access variables are dichotomous. The link function of equation [5] can be easily modified to reflect a logistic regression as in equation [6].

$$[6] \quad ln\left[\frac{P(Y_{itr})}{1-P(Y_{itr})}\right] = \beta_0 + \beta_t Year_t + \beta_r Region_r + \beta_{tr} GMFpar_{tr} + \beta_x X_{itr} + \varepsilon_{itr}$$

It is possible to use linear regression to analyze a dichotomous outcome when two criteria are met: first, the model is not predictive, only observational; and second, the outcome is common. In this fashion, the average treatment effect can be more easily interpreted directly from the linear regression coefficient as the change in reported access due a unit change in GMF participation. For the purposes of my analysis, outcomes deemed common are analyzed first using linear regression and then with logistic regression for verification. For rare outcomes, I employ logistic regression.

With logistic regression, effect estimates are generally reported in the form of odds ratios. However, the interpretation of the OR in the context of my analysis is not greatly useful, being a relative effect as opposed to an incremental effect. Furthermore, the OR is known to overestimate effects in general and more so when the outcome is common or the effect estimate is large (Davies, Crombie, & Tavakoli, 1998). However, coefficients from a logistic regression can be transformed to report other measures of effect including risk ratios and risk differences. By reporting the risk difference calculated from the estimates of a logistic regression, I can report the ATE due to a unit change in GMF participation.

I examine two other models in my analysis. In my second model, I include an interaction term between GMF participation and year fixed effects to allow potential differential impacts of the policy by year as in equation [7]. This analysis will help clarify how quickly any effects of the policy take place and whether they are sustained over time.

$$[7] \quad Y_{itr} = \beta_0 + \beta_t Year_t + \beta_r Region_r + \beta_{tr} GMFpar_{tr} + \beta_{tr*t}(GMFpar_{tr} * Year_t) + \beta_x X_{itr} + \varepsilon_{itr}$$

In my third model, I include an interaction term between region and year to investigate the potential for unobserved time-varying confounding in the impact of GMF participation on reported access to primary health care.

$$[8] \quad Y_{itr} = \beta_0 + \beta_t Year_t + \beta_r Region_r + \beta_{tr} GMFpar_{tr} + \beta_{t*r}(Year_{t\ cont} * Region_r) + \beta_x X_{itr} + \varepsilon_{itr}$$

However, in this instance $Year_t$ within the interaction term will be treated as a continuous variable as opposed to a categorical variable. The interaction of categorical $Year_t$ with categorical $Region_r$ would likely be collinear with the GMF participation variable.

6.3.1 Suitability of the modified DD design for my analysis

The modification of the DD design to accommodate my analysis removes the stark before-after and treatment-control comparison. However, my regression model is similar to others previously used and applies elements and assumptions of the DD design that control for common time trends across regions and unobservable time-invariant differences between regions to isolate the treatment effect of exposure to the GMF policy. In the standard DD model, exposure to a policy is measured by belonging to the affected group in the post-implementation period. As discussed above, Card modified the DD model so that a continuous measure of the population likely to be affected by a policy was interacted with the before-after indicator; Duflo used probable individual exposure time and expected regional program intensity to measure a policy impact. I have tailored the DD effect measure to be a continuous measure of exposure in all regions over time where interaction with a before-after indicator is unnecessary as the exposure measure in the pre-period is zero by definition.

In addition, I have multiple years of data collection and multiple regions for comparison. Aside from use in the regression model, the multiple time points allow me to examine trends in the outcome prior to GMF implementation. With many regions for comparison I have more information on variation in GMF participation and reported access. The 15 groups I use will contribute to reducing any bias due to potential serial correlation of my outcome variables (Bertrand et al., 2004).

6.3.2 Testing DD design assumptions for my data

I first calculated GMF participation for each Quebec health region in 2004 (early after implementation) and divided the 15 health regions into quintiles based on their GMF participation measure. Because I do not have specific treatment and control groups, I instead compared the relatively more exposed regions in the highest GMF participation quintile to relatively less exposed regions in the lowest participation quintile. I repeated the same process under various other conditions. I measured GMF participation in 2011 (late in implementation) and again compared highest and lowest quintiles. I used two different measures of area-level GMF participation, based on physician participation and patient participation in the GMF model, to construct the quintiles. Lastly, because Montreal is so different from most other health regions, I completed the analysis with and without Montreal in the sample.

To examine the exchangeability assumption, I compared 2001 pre-implementation characteristics for regions in the lowest and highest quintiles of GMF participation. I looked for significant differences between the quintiles in reporting of access measures, demographics, social and economic characteristics, and factors that might influence health care utilization and potential access. Significant differences between the highest and lowest quintiles are where means and proportions have non-overlapping 95% confidence intervals.

In testing exogeneity of GMF participation, I compared 2001 pre-implementation and 2010 post-implementation characteristics for lowest and highest quintiles of GMF participation as measured in 2004. I do not include access measures in this analysis given that we would expect differences between quintiles due to the potential influence of GMF participation, but rather characteristics that I expect to remain constant including mean age and sex distribution. Significant differences, as before, are determined by non-overlapping 95% CIs and I looked for changes in one quintile that do not appear in the other to detect potential time-varying differences

Again, I use the highest and lowest GMF participation quintiles in 2004 to test the common outcome trends assumption in the pre-period. I plot percent of the population reporting access

to primary health care over time for the two GMF participation quintiles and visually examine them.

Finally, for placebo testing, I employed a placebo outcome rather than the other methods identified above. With my continuous measure of exposure, changing the time of implementation would not necessarily negate later impact of the policy. As well, the GMF policy is meant to benefit the entire population of Quebec, therefore restricting the analysis to a specific subgroup would not be an appropriate placebo test. If we believe that GMFs are designed to increase access to primary health care then nearly all health-related variables available in the CCHS cannot be used; the majority of them can plausibly be affected by better primary health care access. Health behaviours such as smoking, vegetable consumption, daily exercise, etc. can be influenced by health promotion received through primary health care. Number of visits to specialists or to an emergency department is also likely to be related to an individual's access to care. I elected to test the outcome of respondents reporting an injury suffered in the last 12 months, as this variable was among the few asked of all individuals that is likely to be unaffected by changes in access to primary health care. While treatment for injuries may be affected by access to primary health care, the incidence of injuries is unlikely to be affected by such access.

6.3.3 Variance estimation

The complexity of the design of the CCHS means that individuals are not sampled with equal probability which results in the necessary use of bootstrap re-sampling techniques for valid variance estimation (Statistics Canada, 2011). I previously discussed recommended standard error estimation procedures for analysis using the difference-in-differences design. Unfortunately, Stata does not allow clustering of standard errors, or any other form of variance estimation, when the bootstrap re-sampling required by Statistics Canada is applied.

Instead, I researched the CCHS survey design and how its bootstrap weights are calculated. The CCHS has three sampling frames with an area frame and a telephone frame representing the majority of sampling. The latter two frames use sampling techniques that stratify either geographical areas or telephone list frames by health region. Then within each health region,

dwellings are selected where individual selection probabilities are based on age and household composition (Statistics Canada, 2001b). The calculation of bootstrap weights begins with a simple random sample with replacement of (n-1) clusters from each stratum in the sample. The available documentation does not specify what the strata and clusters are. However, if the survey design is based on strata of health regions, then it is reasonable to assume that the bootstrapping documentation also means health region strata. Non-selected subjects receive a weight of zero for the replicate. Thus, the survey weight for each record in the (n-1) clusters is rescaled to once more represent the Canadian population. These weights are then post-stratified according to demographic information specific to the original stratum and are the final bootstrap weights for that replicate. This process is repeated for B=500 replicates.

The process of variance estimation using bootstrap re-sampling first performs the intended analysis on the original sample with the original survey weights to produce the unbiased estimator $\hat{\theta}$. Then the analysis is repeated within each bootstrap replicate by applying the associated bootstrap weights to produce $\hat{\theta}_i$, the estimator for replicate *i*. The bootstrap variance is then calculated according to equation [9][9] V_{BOOT}.

$$[9] \quad V_{BOOT}(\hat{\theta}) = \frac{1}{B}\sum_{i=1}^{B}(\hat{\theta}_i - \hat{\theta})^2$$

Because the bootstrap variance is calculated exclusively from the unbiased and replicate estimators, we cannot apply other variance estimation procedures. However, the bootstrap weights are calculated separately for each survey year and are meant to account for survey design. Given that the CCHS design appears clustered at the health region level, I can then propose that using the bootstrap technique captures at least some of the clustering by health region and year in the variance estimation.

6.4 Logistic regression, marginal effects and bootstrap re-sampling

To estimate the average marginal effect, or risk difference, from the logistic model coefficients, we generally use the Stata command `margins` and option `dydx(varlist)`. However, because I use a non-OLS standard error estimation technique, an additional option

`vce(unconditional)` is required that allows margins to utilize the same variance estimation technique as the original regression. Unfortunately, `vce(unconditional)` does not support bootstrap re-sampling techniques. In order to have `margins` report appropriate standard errors when using bootstrapping, a completely different method of approach is required. We must write a simple program that allows us to estimate both the regression model and marginal effects with bootstrapping. We store our regression model in a local macro, apply our new margins program to this stored macro, and finally apply bootstrapping via the `svy bootstrap` prefix to both the new margins program and the local macro together. The syntax for this program and other commands can be found in Appendix B and is inspired by the Stata version 13 user manual in the svy postestimation section (StataCorp, 2013) with thanks to Dr. Samuel Harper of the Department of Epidemiology, Biostatistics and Occupational Health of McGill University for directing me to this source and tweaking the code for my analysis.

Section III: Results and Discussion

7. Results

7.1 Variation in GMF participation and reported access

The share of physicians participating in the GMF model varies both across health regions and over time, as we can see in the series of maps of Quebec's health regions below in Figure 7.1 and Figure 7.2. In Figure 7.2, the lightest blue refers to the regions, including Montreal, with the smallest change in GMF participation between 2003 and 2010 relative to the mean; while the darkest blue indicates the region with the greatest change relative to the mean. The share of the population enrolled as patients in GMFs similarly varies by region and year; maps showing the variation in patient GMF participation are found in Appendix C: Results Part I: Maps.

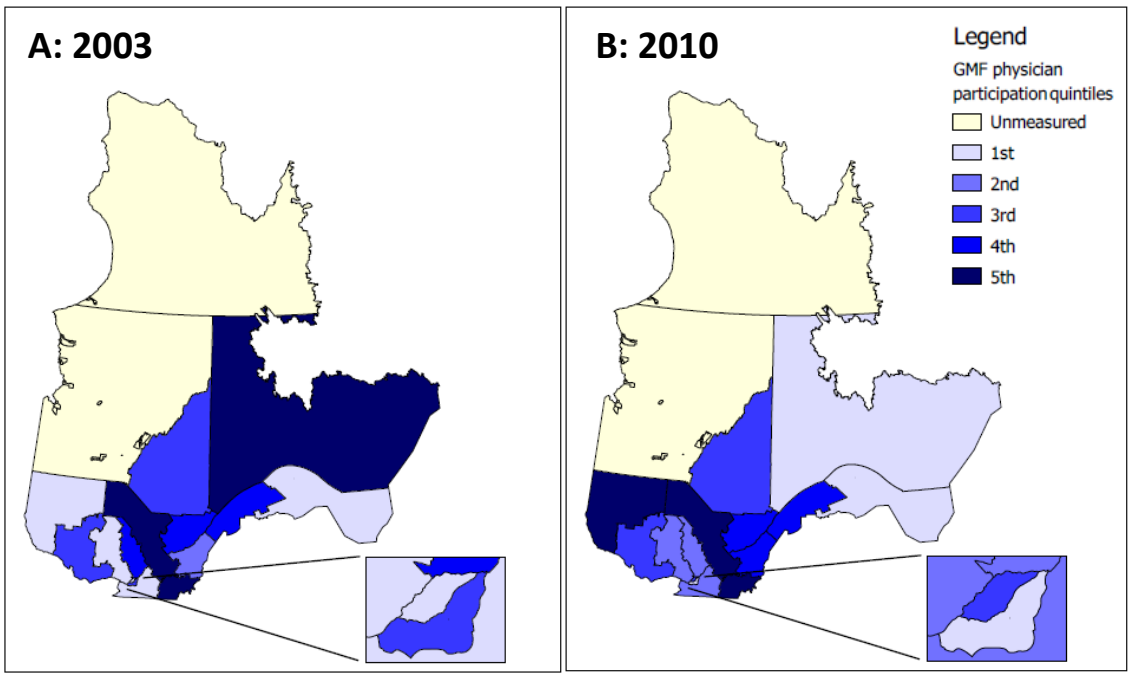

Figure 7.1 Map of Quebec with quintiles of physician GMF participation in 2003 (Panel A) and 2010 (Panel B). Lowest participation is shown in the lightest blue and highest participation in the darkest blue. Health regions where participation was not measure are shown in beige. The transfer of Montreal from a relatively high quintile in 2003 to the lowest quintile in 2010 is due to the overall very low level of initial participation in year 2003. The small number of GMFs that were initially opened in Montreal regions was still higher than most others. However, by 2004 Montreal had dropped to the 1st quintile. For Côte-Nord, its transition from the highest participation quintile occurred later, beginning to drop ranks in 2008 and steadying in the lowest quintile by 2009.

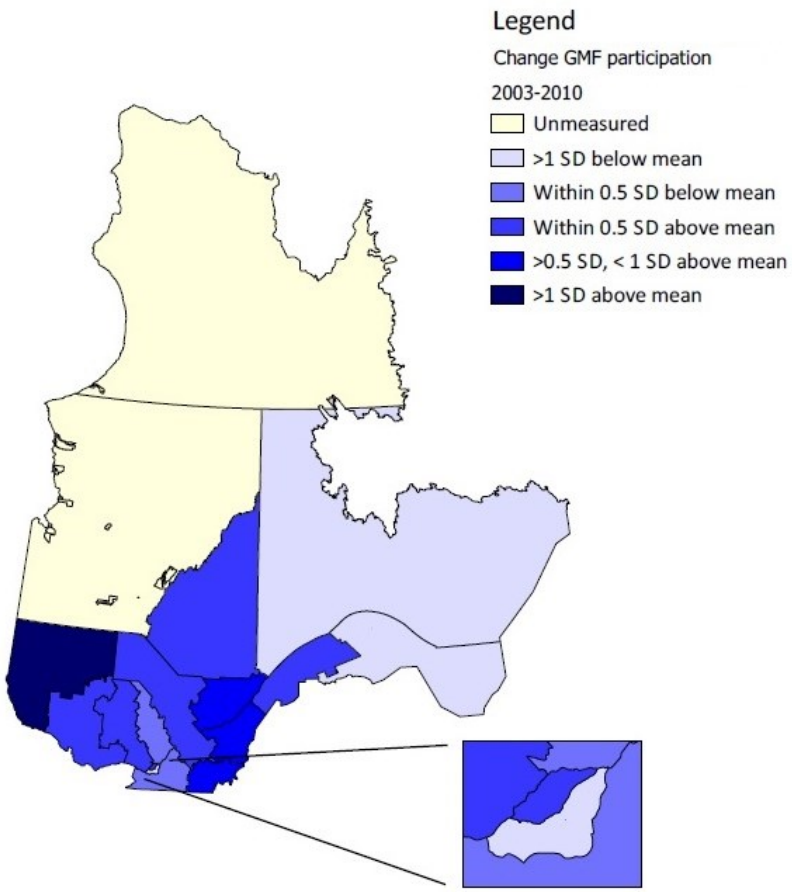

Figure 7.2 Map of Quebec with categories of change in physician GMF participation, relative to the mean, by health region between 2003 and 2010. The categories are based on intervals of half standard deviations away from the mean and there were no regions with a change between 1 SD and 0.5 SD below the mean change.

Reported access to primary health care also varies by health region and year. Figure 7.3 shows the percentage of the population reporting having a regular medical doctor by health region for 2003 and 2010. There are obvious differences in the levels of reported access between health regions which are reasonably persistent over time, with Montreal, region 6, demonstrating the lowest reported access level in all of Quebec in both 2003 and 2010 whereas Bas-Saint-Laurent and Chaudière-Appalaches, regions 1 and 12, have among the highest population share with a regular doctor in both years.

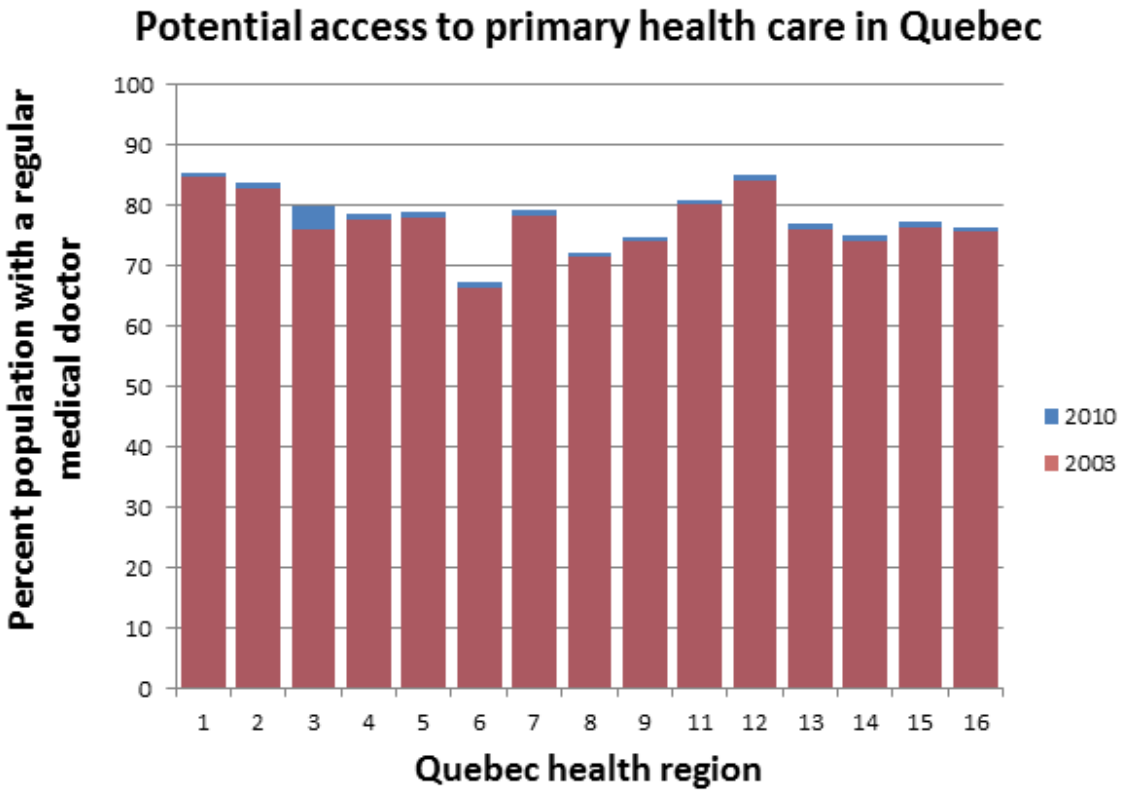

Figure 7.3 Graph indicating the percent of population reporting a regular medical doctor by Quebec health region for 2003 and 2010. Health regions 10, 17 and 18 (Nord du Québec, Nunavik and Terres-Cries-de-la-Baie-James) are not shown here. Differences in reported access levels by health region are evident, with Montreal, region 6, among the lowest levels of access in all of Quebec.

7.2 Testing assumptions of the DD model

Because my analysis utilizes a continuous measure of GMF exposure as opposed to a dichotomous indicator for policy implementation and control groups, I use Quebec health regions belonging to the lowest and highest quintiles of GMF participation for the purposes of comparing pre-period characteristics and examining outcome trends. I examined access in more exposed regions before and after the policy, relative to the change in less exposed regions over the same period.

7.2.1 Pre-GMF policy characteristics of regions of highest and lowest GMF participation

In my attempt to assess the treatment and control group exchangeability assumption, I examined pre-GMF implementation characteristics recorded in 2001 for health regions in the lowest and highest physician GMF participation quintiles measured in 2004; selected results are

presented in Table 7.1 [for the full table of characteristics, see Table C–1 Appendix C Part II]. In 2004, the health regions in the lowest participation quintile are Montreal, Gaspésie-Iles-de-la-Madeleine, and the Laurentides while the highest participating regions are Mauricie-Centre-du-Québec, Côte Nord, and Chaudière-Appalaches. The age and sex structure of the lowest and highest regions are very similar but they differ on several important demographic and socioeconomic characteristics. The main source of the differences is the inclusion of Montreal in the lowest GMF participation quintile. Montreal has the largest population of all the health regions of Quebec and its metropolitan aspects result in significantly larger immigrant and visible minority populations, higher educational attainment, greater use of English, and a higher proportion of the population within the high income adequacy category. As well, the completely urban location of all Montreal residents contrasts with the varied urban and rural geographies of other health regions.

In terms of characteristics that might predispose individuals towards accessing health care, the highest GMF participating regions differ from the lowest in percent of visible minorities at 0.97% (0.47, 1.46) versus 15.54% (13.8, 17.41). Household educational attainment is generally greater in the lowest quintile where the percent of the population not completing high school or having a trade school, CEGEP or university certificate is lower, and the percent with a university degree (bachelor or higher) is greater. Otherwise, minimal and predominantly non-significant differences are seen for mean age, sex, and marital status.

Among enabling characteristics are immigration status and length of stay, household income, language proficiency, sense of community belonging and geographic location. For regions of highest participation, the percent of the population born in Canada is much higher at 98.13% (97.50, 98.76) compared to 72.15% (69.93, 74.34) in the lowest regions. There are more middle income adequacy households in higher participating regions but fewer high income adequacy households. More individuals identify French only as a language of proficiency in the highest participation quintile compared to the lowest quintile at 76.02% (73.40, 78.13) and 31.16% (29.47, 32.86) respectively; and many more in the lowest quintile report proficiency in both French and English, 57.67% (55.81, 59.54) compared to 22.46% (20.37, 24.56). The detailed

geographic variable (based on categories of geographic availability of health services) places 15.37% (13.06, 17.68) of the highest participation population within the influence of large urban centers whereas 80.50% (79.32, 81.68) of the lowest quintile population is found in the same category. Individuals' sense of belonging to their local community differed only in that fewer in the lowest quintile reported a very weak sense of community belonging compared to regions of highest participation.

For health need measures, no differences between the highest and lowest participating regions appear in reporting of self-perceived health or number of physician-diagnosed chronic conditions.

Table 7.1 Selected pre-implementation (2001) characteristics for regions in the highest and lowest GMF participation quintiles as measured in 2004. Significant differences between quintiles at the α=0.05 level are bolded.

CCHS 1.1 (2001)	Pre-implementation characteristics of region in lowest and highest quintiles of GMF physician participation of 2004					
	Q1			Q5		
	%	95% CI		%	95% CI	
AGE (mean)	45.65	45.41	45.88	45.66	45.40	45.91
SEX						
Female	51.63	51.38	51.87	50.22	49.89	50.55
Male	48.37	48.13	48.62	49.78	48.45	50.11
ETHNICITY						
Visible minority	**15.54**	13.68	17.41	**0.97**	0.47	1.46
White	**83.33**	81.41	85.25	**98.51**	97.89	99.14
EDUCATION						
<High school degree	**24.76**	23.10	26.42	**35.74**	33.46	38.02
High school degree	14.45	13.16	15.73	14.44	12.96	15.93
Some post high school	**7.82**	6.82	8.83	**5.29**	4.30	6.28
Trade school/CEGEP/ University certificate	**30.35**	28.87	31.84	**34.66**	32.66	36.65
University degree	**22.02**	20.26	23.77	**9.48**	8.00	10.95
IMMIGRATION STATUS						
Born in Canada	**72.15**	69.93	74.34	**98.13**	97.50	98.76
INCOME ADEQUACY						
Middle	**22.42**	20.98	23.87	**28.20**	26.15	30.25
Middle-High	31.83	30.02	33.63	35.78	33.56	38.00
High	**23.42**	21.42	25.41	**15.61**	13.70	17.51
LANGUAGE PROFICIENCY						
French, not English	**31.16**	29.47	32.86	**76.02**	73.90	78.13
English, not French	**7.79**	6.57	9.01	**0.91**	0.14	1.64

French and English	**57.67**	55.81	59.54	**22.46**	20.37	24.56
GEOGRAPHIC AVAILABILITY CATEGORY						
Large center	**80.50**	79.32	81.68	**15.37**	13.06	17.68
Subspecialized center	**3.77**	2.45	5.09	**18.85**	16.04	21.66
Peripheral spec center	**8.22**	6.65	9.79	**31.77**	27.20	36.34
Regional spec center	**1.16**	0.84	1.48	**4.72**	3.79	5.65
Peripheral rural zone	**1.99**	1.21	2.77	**23.14**	18.33	27.95
SELF-PERCEIVED HEALTH						
Excellent	26.73	25.06	28.41	25.81	23.98	27.65
Very good	33.15	31.44	34.86	32.12	30.33	33.91
Good	28.15	26.45	29.85	30.22	28.47	31.98
Fair	9.39	8.39	10.40	9.99	8.83	11.16
Poor	2.51	1.91	3.11	1.85	1.37	2.33
REGULAR DOCTOR						
No	**33.05**	31.32	34.78	**25.27**	23.36	27.18
Yes	**66.87**	65.12	68.60	**74.65**	72.74	76.57
UNMET CARE NEEDS						
No	85.92	84.58	87.27	87.94	86.56	89.33
Yes	13.99	12.66	15.32	11.97	10.58	13.36
PAP TEST*						
No	32.11	29.72	34.50	37.11	34.16	40.06
Yes	61.54	59.22	63.84	55.63	52.70	58.56
N	**4859**			**3754**		

Note:
*restricted to females 18 years and over
The health regions corresponding to the GMF participation quintiles are given below.
2004
Q1: Montréal-Centre, Gaspésie-Iles-de-la-Madeleine, Laurentides
Q5: Mauricie-Centre-du-Québec, Côte Nord, Chaudière-Appalaches

I examined outcome variables for 2001 in the same manner for highest and lowest GMF participation quintiles (some measures in Table 7.1 and all measures in Appendix C Table C–2 and Table C–3). A significantly higher proportion of individuals in the highest participation quintile reported having a regular medical doctor at 74.65% (72.74, 76.57) compared to 66.87% (65.12, 68.60) in the lowest quintile. By contrast reporting of unmet health care needs, receipt of a flu shot within the past year, and receipt of a mammogram within the past two years did not differ between quintiles. More women in the lowest than the highest GMF participation quintile reported receiving a Pap test within the past three years, 61.54% (59.22, 63.84) versus 55.63% (52.70, 58.56). Other access outcomes including difficulty accessing health information,

routine care or immediate care for minor health problems also showed no difference in reporting between the quintiles. For difficulty accessing care at different times of the day, it is difficult to determine if there are significant differences between quintiles due to small sample sizes, especially within one year of reported access outcomes, which results in very wide confidence intervals.

Though some differences between the lowest and highest GMF participation regions are evident, I can control for these factors in my multivariate regressions and second, that to the extent these are fixed regional differences (e.g., Montreal always has more immigrants) then they, as well as any other unobserved confounders, are controlled for in the region fixed effects term of the DD model.

Because GMF implementation occurred in late 2002, participation measured in 2004 would represent conditions early within the implementation period. To see if differences could be found between high and low participation measured later in implementation, I looked at the same set of characteristics for quintiles measured in 2011 (Table C–1). The three lowest participating regions of 2011 are Montreal, Côte Nord and Gaspésie-Iles-de-la-Madeleine and the three highest are Mauricie-Centre-du-Québec, Estrie and Abitibi-Témiscamingue. The same pattern of differences as seen with 2004 participation levels was maintained between the 2011 quintiles, most likely due to the persistence of regions within quintiles and the continued presence of Montreal within the bottom quintile. Between the 2004 and 2011 quintiles, few differences exist in the pre-implementation characteristics. However, for regions of 2011 highest GMF participation, a lower percentage of the population reported proficiency only in French compared to the 2004 highest quintile; in accordance with the drop in French only, there was an increase in reporting of both French and English proficiency in the 2011 highest quintile. The distribution of regional populations among the geographic location categories also changed, but again, only between the highest GMF participation quintiles of 2004 and 2011. For reported access outcomes, the only difference between the 2004 and 2011 quintiles is that there is no longer a significant difference between the highest and lowest quintiles in reporting the receipt of a Pap test for women 18 and over.

The dissimilarities between the 2004 and 2011 participation quintiles are likely due to the regions included. Côte Nord, being a much more northerly region would have an increased proportion of individuals in more rural areas. The transfer of Côte Nord out of the highest quintile between 2004 and 2011 contributed to the change in distribution of geographic categories for highest GMF participation quintiles as well as to the decreased percent of the highest quintile population reporting only French as a language of proficiency.

Due to the divergence of Montreal from other regions in important characteristics, I again examined the same variables (table available upon request) but now for the lowest GMF participation quintile not including Montreal. In 2004 Montreal is replaced by the health region of Outaouais; in the 2011 lowest quintile, Montérégie takes Montreal's place. By eliminating Montreal, the differences between the lowest and highest participation quintiles shrink but most maintain significant differences in the same characteristics previously described.

By excluding Montreal, the proportion of the population in the lowest quintile reporting a regular medical doctor increased by a large amount and became significantly higher than that reported in the highest 2004 quintile. Other reported access outcomes did not change significantly when Montreal was removed from the sample except receipt of a Pap test which was reported at significantly higher proportions compared to when Montreal was included.

As touched on above, the health regions included within the quintile influence the group characteristics and reported outcomes. Montérégie is a health region adjacent to Montreal and with an important population size; thus the presence of Montérégie would result in a large proportion of the quintile population being within the influence of a large urban center. Outaouais is found along the Ontario border and includes Gatineau, the sister city of Ottawa; a large language and geographic influence can therefore be expected from its inclusion in the 2004 lowest quintile.

As an aside, all the above statistics are based on the quintiles of *physician* GMF participation. I also investigated quintiles based on *patient* GMF participation and found that dividing regions into quintiles based on the patient measure rather than the physician measure did not

significantly alter reporting of characteristics using all the above scenarios (2004 versus 2011; with Montreal versus without Montreal).

7.2.2 Pre and post-GMF policy characteristics of regions of highest and lowest GMF participation

To determine if population composition changed in response to the implementation of GMFs, I compared 2001 characteristics (not including outcome variables) to those recorded in 2010 for highest and lowest GMF participation quintiles measured in 2004 – again I looked at the lowest quintile both with the Montreal health region (Table C–4) and without Montreal included (table available upon request).

For results including Montreal in the lowest participation quintile, I found a significant increase in the percent of visible minorities in the lowest participation quintile from 15.54% (13.68, 17.41) in 2001 to 23.01% (20.11, 25.90) in 2010; a change which is not reflected in the highest GMF participation regions. A decrease in the percentage of married individuals was found for the lowest quintile, while the highest had an increase in the common-law category. Fewer individuals in the highest participating regions reported French only as a language of proficiency with more speaking both French and English. In only the highest quintile, fewer people reported being born in Canada, 98.13% (97.50, 98.76) compared to 95.46% (94.14, 96.78); however, low cell counts in other categories precluded the investigation of other changes. In both quintiles, there was a decrease in the percent of the populations with less than a high school degree and an increase in the number of individuals receiving a trade school degree, CEGEP degree or university certificate. Only in the lowest quintile did I find an increase in number of individuals receiving a university degree from 22.06% (20.26, 23.77) to 27.66% (24.85, 30.46). These differences over time seen in one quintile and not in the other can be controlled for by including those variables in the regression equation. In addition, the changes are small and what we might expect as some more rural regions urbanize over time (compared to regions such as Montreal where change is less likely); the differences should not pose a threat to the assumption of exogeneity of GMF implementation.

Other changes that were seen in both quintiles include decreases in the proportion of the population belonging to low, low-middle, middle, and middle-high income adequacy groups with a concomitant increase in high income adequacy. This shift in distribution of the income adequacy variable likely reflects the average increase in earnings from 2001 to 2010 while the same income adequacy category definitions were maintained for all years of the study. Similar differences in reporting of sense of community belonging were found in regions of both quintiles. Lastly, fewer people in both the lowest and highest quintiles reported no physician-diagnosed chronic conditions while a greater proportion of these populations reported three or more chronic conditions. Changes that were seen in both quintiles will be controlled for by the year fixed effects term in the regression analysis.

While all estimates were recalculated excluding Montreal in the lowest GMF participation quintile, all detected differences were equivalent to those discussed above.

7.2.3 Temporal trends in reported access

In general, reported access to primary health care has increased over time across all regions of Quebec. Figure 7.4 demonstrates this trend for individuals reporting a regular medical doctor. In 2001, before the GMF policy was implemented, the percentage of the population who reported having a regular medical doctor was 71.99% (71.12, 72.86) and this percent increased to 75.61% (74.40, 76.83) in 2010, roughly seven years after the program was launched. The evident temporal trend in the outcome across all regions must be controlled for in the DD analysis in order to isolate a causal effect of GMF participation.

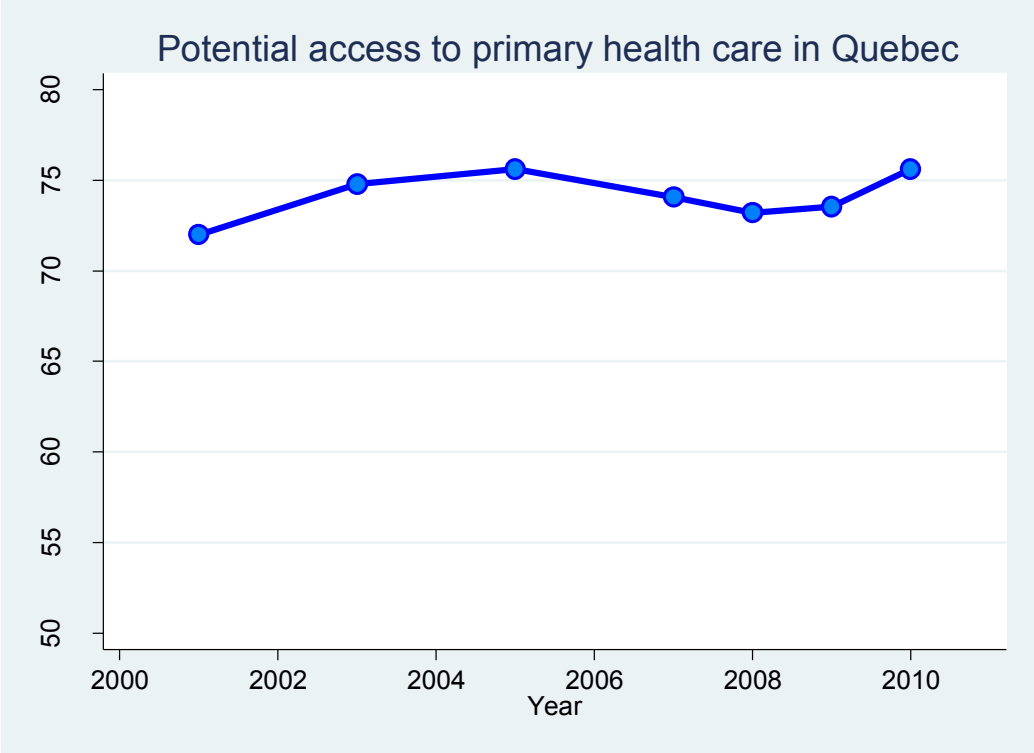

Figure 7.4 Trend from 2001 to 2010 in percentage of the population reporting a regular medical doctor across all regions of Quebec. The trend is generally increasing between 2001 and 2010, though in a non-linear trajectory.

To investigate the assumption of common outcome trends in the absence of policy implementation, I examined the trend in reported access separately for regions of highest and lowest GMF participation quintiles measured in 2004 in the pre-implementation period. Figure 7.5 shows that regions of highest and lowest participation have roughly parallel trends in the percent of the population reporting a regular medical doctor in the pre-policy period, to the left of the dashed vertical line. This line is found at year 2004, recalling that recording of GMF data is available first in 2003 and that there is a one year gap between when GMF participation is recorded and when reported access is measured. Interestingly, while we can see that regions with better reported access are those that have higher GMF participation, it is also important to note that this trend is maintained before and after the implementation of the GMF policy. The pre-implementation parallel trends offer support for the critical common trends assumption of the DD model. In addition, the post-implementation trends may offer some early evidence that GMF participation is not a cause of increased access to primary health care.

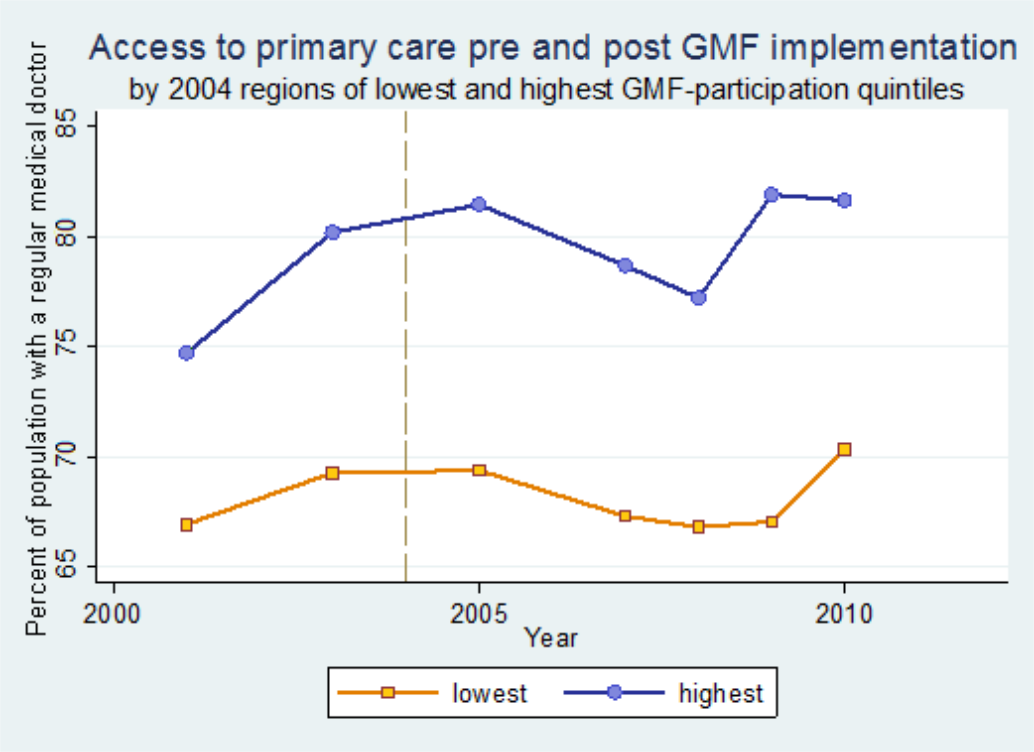

Figure 7.5 Outcome trends for the percent of individuals who report having a regular medical doctor by 2004 quintile of GMF participation (physician). The dashed vertical line at Year=2004 indicates the time at which GMF policy implementation would have begun to impact CCHS access responses.

7.2.4 Summary of DD model assumption testing

The three main assumptions of the difference-in-differences design are exchangeability of treatment and control groups, exogeneity of the policy implementation, and common trends in the outcome in the absence of the policy. I have described how such differences as exist between the health regions included in my analysis are expected and understandable and that these fixed differences between regions can be controlled for in the DD design through the inclusion of region fixed effects. The absence of significant and relevant changes in population characteristics over time in regions of highest participation versus lowest participation supports the assumption of exogeneity of GMF implementation. By examining the trends in the outcome over time, I demonstrated a clear overall trend that must be taken into account; and finally, the parallel outcome trends for regions of highest and lowest GMF participation suggest the common trends assumption holds. Altogether, these results allow me to proceed with regression analysis in an attempt to isolate a causal impact of GMF participation on reported access to primary health care.

7.3 DD regression model results

Most independent and control variables in my regression models are categorical so that, in linear models, the coefficients on the variable categories represent the *proportion* of reported access explained by the change from the reference category of those variables. For continuous variables, the coefficient represents the *change in proportion* of reported access for a one unit change in the independent variable, for example, a one year increase in age. The GMF participation variable is continuous but is itself measured as a proportion and not as a percent – i.e. a one percentage point change would be given by 0.01 units. Therefore *the coefficient on GMF participation in the linear regression directly represents the percentage point change in reported access that is attributable to the effects of a one percentage point increase in GMF participation.* From logistics models, the coefficients are not so easily interpreted; and the exponentiated form that produces an odds ratio is also not terribly informative as it is a relative effect. Instead, I transform the coefficients to report average marginal effects that have an equivalent interpretation as linear coefficients.

7.3.1 Evolution of DD model

The importance of including year and region fixed effects in the difference-in-differences model can be seen in Table 7.2 for the outcome of having a regular medical doctor and using physician participation as the measure of GMF exposure. In the raw, unadjusted model with GMF participation as the only independent variable, there is a positive and significant treatment 'effect' of GMF participation; a 0.097 (0.075, 0.12) percentage point increase in reported access for a one percentage point increase in GMF participation. When year fixed effects are added to account for the increasing trend in reported access over time, the 'effect' of GMF participation rises to a 0.37 (0.31, 0.43) percentage point increase in reported access. However, when including GMF participation and region fixed effects, the impact of GMF participation disappears and becomes non-significant at 0.015 (-0.0090, 0.040) percentage points. The fixed differences in reported access across health regions are clearly correlated with the changes in GMF participation over time. In my modified DD model that includes GMF participation, year fixed effects and region fixed effects, the coefficient on GMF participation becomes negative

and non-significant at -0.031 (-0.11, 0.049). The fully adjusted DD model incorporating GMF participation, the two fixed effects as well as all the chosen covariates also has a negative and non-significant effect of -0.061 (-0.14, 0.022) percentage point change in reported access for a one percentage point increase in GMF participation.

To verify that linear regression can be used with prevalent dichotomous outcomes, I repeated the same models from Table 7.2 but using logistic regression. Table 7.3 gives the average marginal effect for physician GMF participation on having a regular medical doctor; we can see that the linear coefficients on GMF participation closely approximate the average marginal effects obtained from the logistic version of the model. From these results, I can confidently report the linear regression results for other prevalent outcomes.

As I examined descriptive statistics above with various conditions and restrictions, I also performed regression analysis under different conditions. I repeated the same analysis of the evolution of the DD model first using patient participation as the main measure of exposure to GMFs in Table 7.4 and then, with physician participation, restricting the sample to exclude the Montreal health region in Table 7.5. The coefficient on patient GMF participation demonstrates the same shrinking of effects as seen for physician participation with the introduction of region fixed effects. However, when Montreal is removed from analysis, the GMF participation coefficient is non-significant through all versions of the model. It seems that including Montreal's low participation and low reported access contributes to the overall 'effect' detected in Table 7.2 when GMF participation is the only independent variable. The coefficient on GMF participation in the full DD model without Montreal is non-significantly different from the one found using the full sample.

For the remainder of this chapter, I will only report results from regression analyses using physician GMF participation as the main independent variable and the full sample including Montreal, unless otherwise specified.

Table 7.2 Coefficients on GMF participation, year fixed effects and region fixed effects for various models. Statistically significant results at α=0.05 are bolded.

	GMFpar			GMFpar + Year			GMFpar + Region			GMFpar + Year + Region (DD)		
	β	95% CI		β	95% CI		β	95% CI		β	95% CI	
GMFpar	**0.097**	**0.075**	**0.12**	**0.37**	**0.31**	**0.43**	0.015	-0.0090	0.040	-0.031	-0.11	0.049
Year 2001				----	----	----				----	----	----
2003				**0.028**	**0.016**	**0.040**				**0.028**	**0.016**	**0.041**
2005				-0.011	-0.025	0.0023				**0.040**	**0.025**	**0.056**
2007				**-0.052**	**-0.073**	**-0.032**				**0.027**	**0.0033**	**0.050**
2008				**-0.082**	**-0.10**	**-0.060**				0.020	-0.0070	0.047
2009				**-0.11**	**-0.13**	**-0.079**				0.026	-0.0080	0.059
2010				**-0.12**	**-0.15**	**-0.086**				**0.049**	**0.011**	**0.087**
HR 1							**0.088**	**0.072**	**0.10**	**0.091**	**0.074**	**0.11**
2							**0.073**	**0.055**	**0.091**	**0.072**	**0.054**	**0.090**
3							**0.032**	**0.016**	**0.049**	**0.034**	**0.017**	**0.051**
4							**0.019**	**0.0014**	**0.037**	**0.025**	**0.0054**	**0.044**
5							**0.023**	**0.0023**	**0.043**	**0.025**	**0.0041**	**0.046**
6							**-0.091**	**-0.11**	**-0.076**	**-0.094**	**-0.11**	**-0.078**
7							**0.028**	**0.0089**	**0.046**	**0.027**	**0.0084**	**0.046**
8							**-0.044**	**-0.065**	**-0.022**	**-0.041**	**-0.062**	**-0.019**
9							-0.017	-0.044	0.0091	-0.015	-0.042	0.011
11							**0.046**	**0.026**	**0.066**	**0.043**	**0.023**	**0.064**
12							**0.084**	**0.067**	**0.10**	**0.087**	**0.070**	**0.10**
13							0.0036	-0.016	0.023	0.0051	-0.014	0.025
14							-0.016	-0.035	0.0034	-0.015	-0.035	0.0042
15							0.0082	-0.0096	0.026	0.0073	-0.010	0.025
16							----	----	----			
Cons	0.73	0.72	0.73	0.72	0.71	0.73	0.75	0.74	0.76	0.73	0.71	0.74
N	**113746**			**113746**			**113746**			**113746**		

Table 7.3 Average marginal effect of physician GMF participation on reported access to a regular medical doctor for various logistic models. Statistically significant effects at α=0.05 of GMF participation are bolded.

	Average marginal effect of GMFpar from logistic models			
Model	**Mrg effect**	**95% CI**		**N**
GMFpar	**0.099**	**0.076**	**0.12**	**113746**
GMFpar + Year	**0.38**	**0.32**	**0.44**	**113746**
GMFpar + Region	0.016	-0.0095	0.042	113746
GMFpar + Year + Region	-0.025	-0.10	0.052	113746
GMFpar + Year + Region + covar	-0.057	-0.14	0.024	95370

Table 7.4 Coefficients of patient GMF participation on reported access to a regular medical doctor in various linear models. Statistically significant effects at α=0.05 of GMF participation are bolded.

	Coefficient of GMFpar from linear models using patient measure of participation			
Model	**β**	**95% CI**		**N**
GMFpar	**0.18**	**0.15**	**0.22**	**98071**
GMFpar + Year	**0.53**	**0.45**	**0.60**	**98071**
GMFpar + Region	0.021	-0.017	0.060	98071
GMFpar + Year + Region	0.041	-0.059	0.14	98071
GMFpar + Year + Region + covar	-0.0089	-0.11	0.097	82517

Table 7.5 Coefficients of physician GMF participation on reported access to a regular medical doctor in various linear models with the sample restricted to exclude Montreal health region. Statistically significant effects at α=0.05 are bolded.

	Coefficient of GMFpar from linear models using physician participation and excluding Montreal region			
Model	**β**	**95% CI**		**N**
GMFpar	0.019	-0.0049	0.045	113746
GMFpar + Year	0.029	-0.039	0.098	113746
GMFpar + Region	0.014	-0.011	0.039	113746
GMFpar + Year + Region	-0.070	-0.16	0.018	113746
GMFpar + Year + Region + covar	-0.079	-0.17	0.014	95370

7.3.2 Full DD model of potential and realized access outcomes

Table 7.6 to Table 7.9 give the GMF participation coefficient and 95% confidence interval for potential access outcomes (Table 7.6), outcomes measuring access at different times of the day (Table 7.7), realized access outcomes (Table 7.8), and barriers to access outcomes (Table 7.9) in the fully adjusted DD model.

Like reporting having a regular medical doctor, other potential access outcomes also show small and non-significant impacts of GMF participation. For reported unmet health care needs, a non-significant effect of 0.025 (-0.071, 0.12) percentage point increase in reported unmet needs for a one percentage point increase in GMF participation is found with the linear model; however, the overall prevalence of unmet needs is roughly 13% of all individuals across all regions and years so the outcome is relatively rare. When reanalyzing unmet needs with the logistic model, there was a small change in the effect estimate but with a very similar confidence interval: 0.032 (-0.060, 0.12). Similarly, the impact of GMF participation on difficulty accessing certain forms of primary health care (health information, routine care, and immediate care) is positive but non-significant. Again, for health information, the overall prevalence is fairly low at around 16%; however, the small difference in GMF estimates between the linear and logistic models is not reflected in the 95% CIs. It appears that the linear and logistic models closely agree, and lead to the same interpretations even when the outcome is not highly prevalent. This concordance is possibly due to the very small effect estimates of GMF participation on potential access measures thus far. The overestimation of logistic estimates tends to be exacerbated when the relative risk in the population is high and when the effect estimate is large (Davies et al., 1998).

For difficulty accessing health information and immediate care, the smaller sample sizes mean that the 95% CIs are fairly wide; e.g. the GMF participation coefficient for difficulty accessing immediate care is 0.024 with a 95% CI of (-0.32, 0.36). The upper ends of these confidence intervals represent small but potentially important impacts: 0.36 percentage point increase in reporting of difficulty accessing immediate care per one percentage point increase in GMF

participation seems quite high when we know that the highest participating regions by the end of my study years had GMF participation increase to roughly 50-60%.

Table 7.6 Impact of physician GMF participation on potential access outcomes in the fully adjusted DD model. Statistically significant effects at α=0.05 are bolded.

	Coefficient on GMFpar in fully adjusted DD model for potential access outcomes			
Outcome	**β/Marg eff**	**95% CI**		**N**
Regular medical doctor	-0.061	-0.14	0.022	95370
Unmet health care needs - linear	0.025	-0.071	0.12	68787
Unmet health care needs - logistic	0.032	-0.060	0.12	68787
Difficulty accessing health info - linear	0.024	-0.24	0.29	7390
Difficulty accessing health info - logistic	0.053	-0.19	0.30	7390
Difficulty accessing routine care	0.19	-0.021	0.41	11610
Difficulty accessing immediate care	0.024	-0.32	0.36	5340

The fully adjusted DD model is Y=GMFpar + Year + Region + covar
Share of physicians participating in the GMF model is the main exposure variable
Covariates include age, sex, ethnicity, marital status, household education, immigration status and length of stay in Canada, household income adequacy, language proficiency, sense of community belonging, geographic availability of health services, self-reported health status, and number of physician-diagnosed chronic health conditions

Looking at access to primary health care at different times of the day (Table 7.7), I also found only non-significant effects of GMF participation. Smaller sample sizes for these regressions are also found in conjunction with wider confidence intervals. The outcome of experiencing difficulty accessing health information outside of regular office hours has a coefficient of 0.74 percentage points with a 95% CI of (-0.096, 1.57) and a sample size of 814. In the Variables chapter section 5.1.8, I discussed the skip pattern that survey subjects follow when responding to questions about difficulty accessing care at different times of day.

As with potential access outcomes, the effect of GMF participation on realized access outcomes is mostly not statistically significant (Table 7.8). Reports of having a flu shot within the last year shows an effect very close to zero at -0.0011 (-0.079, 0.076) percentage point change in realized access for a one percentage point increase in GMF participation. The effect for this outcome switches signs but remains non-significant when the population is restricted to individuals 65 years and over. The impact of GMF participation on the receipt of a Pap test for

women 18 years and over within the last three years is -0.066 (-0.24, 0.11) percentage point change; however, the impact of GMF participation on the receipt of a mammogram in women 35 years and over is negative and significant at a -0.24 (-0.45, -0.032) percentage point change in realized access for a one percentage point increase in GMF participation. This significance disappears when the population is restricted to women 50 years and over, the age at which recommended mammogram screening begins. Additionally, when restricting to women 35-49, there is no significant impact of GMF participation.

Table 7.7 Impact of physician GMF participation on potential access at different times of the day in the fully adjusted DD model. Statistically significant effects at α=0.05 are bolded.

	Coefficient on GMFpar in fully adjusted DD model for time of day access outcomes			
Outcome	**β**	**95% CI**		**N**
Difficulty accessing health information				
Regular office hours	0.58	-0.014	1.17	1146
Evenings and weekends	0.77	-0.034	1.63	864
Middle of the night	0.65	-0.22	1.52	629
Outside of regular office hours	0.74	-0.096	1.57	814
Difficulty accessing routine care				
Regular office hours	-0.23	-0.71	0.24	2131
Evenings and weekends	0.018	-0.74	0.76	1458
Difficulty accessing immediate care				
Regular office hours	0.25	-0.45	0.96	1271
Evenings and weekends	0.15	-0.70	1.00	1027
Middle of the night	-0.58	-1.48	0.33	759
Outside of regular office hours	-0.096	-0.93	0.74	1002

The fully adjusted DD model is Y=GMFpar + Year + Region + covar
Share of physicians participating in the GMF model is the main exposure variable
Covariates include age, sex, ethnicity, marital status, household education, immigration status and length of stay in Canada, household income adequacy, language proficiency, sense of community belonging, geographic availability of health services, self-reported health status, and number of physician-diagnosed chronic health conditions

Table 7.8 Impact of physician GMF participation on realized access outcomes in the fully adjusted DD model. Significant results at α=0.05 are bolded.

	Coefficient on GMFpar in fully adjusted DD model for realized access outcomes			
Outcome	**β**	**95% CI**		**N**
Flu shot in last year	-0.0011	-0.079	0.076	77741
Flu shot in last year, 65+	0.018	-0.19	0.23	16579
Pap test in last 3 years, females 18+	-0.066	-0.24	0.11	37042
Mammogram in last 2 years, females 35+	**-0.24**	**-0.45**	**-0.032**	**27864**
Mammogram in last 2 years, females 35-49	-0.20	-0.53	0.14	9636
Mammogram in last 2 years, females 50+	-0.21	-0.46	0.034	18228
The fully adjusted DD model is Y=GMFpar + Year + Region + covar *Share of physicians participating in the GMF model is the main exposure variable* *Covariates include age, sex, ethnicity, marital status, household education, immigration status and length of stay in Canada, household income adequacy, language proficiency, sense of community belonging, geographic availability of health services, self-reported health status, and number of physician-diagnosed chronic health conditions*				

Table 7.9 reports average marginal effects from the logistic model for the impact of GMF participation on reported barriers as most outcomes are reported by less than 20% or even 10% of the sample. The impact of GMF participation on barriers to having a regular medical doctor is close to zero and non-significant. While geographic availability, time and financial barriers for unmet health care needs are not impacted by GMF participation, personal barriers for this measure of potential access present a positive and significant coefficient on GMF participation of 0.48 (0.18, 0.78); this coefficient indicates a 0.48 percentage point increase per one percentage point increase in GMF participating for reporting of personal barriers as an explanation of unmet health care needs in the last year. A positive and significant effect is also found when patient GMF participation is used as the measure of GMF exposure, 0.79 (0.45, 1.13) percentage points (Table C–7). In the case of barriers to receiving a flu shot, the logistic model reports only non-significant results; however, the linear model for flu shot geographic availability produced a significantly negative effect of GMF participation at -0.013 (-0.024, -0.0012) percentage point change using physician participation but not patient participation.

Table 7.9 Impact of GMF participation on potential and realized access barrier outcomes in the fully adjusted DD model. Significant results at α=0.05 are bolded.

	Coefficient on GMFpar in fully adjusted DD model for access barrier outcomes			
Outcome	**Mrg effect**	**95% CI**		**N**
Regular medical doctor				
Geographic availability	-0.0076	-0.22	0.20	16847
Personal barriers	0.085	-0.12	0.29	16847
Unmet health care needs				
Geographic availability	-0.10	-0.30	0.091	9014
Personal barriers	**0.48**	**0.18**	**0.78**	**9014**
Time barriers	-0.22	-0.57	0.13	9014
Financial barriers	-0.099	-0.26	0.058	9014
Flu shot within the last year				
Geographic availability	-0.011	-0.023	-0.023	46384
Personal barriers	-0.058	-0.14	0.028	46384
Time barriers	0.021	-0.0085	0.051	46384
Financial barriers	0.021	-0.013	0.054	46384

The fully adjusted DD model is logit(Y)=GMFpar + Year + Region + covar
Share of physicians participating in the GMF model is the main exposure variable
Covariates include age, sex, ethnicity, marital status, household education, immigration status and length of stay in Canada, household income adequacy, language proficiency, sense of community belonging, geographic availability of health services, self-reported health status, and number of physician-diagnosed chronic health conditions

Since I am interested in the reporting of access barriers as a means of thinking about future directions for policies directed at improving access to primary health care, I also examined which barriers have the highest reporting for each access experience (Appendix C Part II Table C–5). The only case in which an important proportion of the population with access deficiencies reported geographic availability barriers was for individuals without a regular medical doctor. Prior to GMF implementation in 2003, 29.81% (65.88, 73.03) of these individuals in the lowest 2004 GMF participation quintile reported geographic barriers to having a regular doctor compared to 42.44% (36.11, 48.78) in the highest quintile. By 2010, this proportion jumped to 49.05% (43.47, 54.62) in the lowest quintile and 62.09% (54.09, 70.09) in the highest. While personal barriers were also reported at a high rate, I found them to be more highly reported in the lowest quintile than the highest prior to GMF implementation. However, late within

implementation, the significant difference in personal barrier reporting between quintiles disappeared, though reporting remained relatively high.

The most reported barriers that resulted in unmet health care needs were those related to wait times and timing of the service availability. Among those in the lowest participation quintile indicating unmet health care needs, 62.62% (57.35, 68.88) reported time barriers as a reason; in the highest quintile the percentage was 59.06% (52.11, 66.01), a non-significant difference. In 2003 in the highest participation quintile, 15.39% (9.88, 20.90) of individuals with unmet needs cited geographic barriers, a significantly higher percent than in the lowest quintile. However, in 2010, geographic barriers had dropped in the highest quintile until there was no difference with the lowest participation quintile. Personal and other barriers were also reported but at lower frequencies and with no differences between quintiles.

For flu shot, Pap test and mammogram, geographic availability and financial barriers seemed to play no part in reasons why a service was not received in the recommended time interval. A small percent of women not receiving a Pap test and/or mammogram identified time barriers but personal barriers, followed by other barriers, were the most significant sources of impendence in accessing any of the three preventive services. I found no significant differences between the highest and lowest GMF participation quintiles in either 2003 or 2010. Overall, it appears that, depending on the access measure being investigated, different barriers are more likely to be reported than others.

7.3.3 Checks of the DD model

Returning to the DD regression analysis, to investigate whether there is a differential impact of GMF participation on reported access over time, I added a term to my DD model interacting GMF participation with year fixed effects (equation [7]). None of the GMF participation-year interactions produced significant impacts on access to a regular medical doctor (Table 7.10). The year 2001 is my reference year in this analysis and the year 2003 contains data on reported access collected prior to GMF implementation; therefore the interaction term GMFpar1*Year will be not be estimated in 2001 and will be zero in 2003. As a result, the interpretation of the GMF participation variable alone is its impact in years 2001 and 2003 only. The impact of GMF

participation in 2001 and 2003 remains non-significant and similar to the original full DD model at 0.14 (-0.032, 0.31) percentage point increase in individuals with a regular medical doctor for a one percentage point increase in GMF participation. Overall, no significant differential impact of GMF participation over time could be detected using this model.

The third model I tested (equation [8]) included an interaction of health region and linear year in an effort to control for time-varying differences between regions. The coefficient on GMF participation is non-significant and very small. Including a region and year interaction term to the full DD model, I found a -0.021 (-0.15, 0.11) percentage point change for having a regular medical doctor for a one percentage point increase in GMF participation. Compared to my original DD model, the absence of an important difference in the estimated impact of GMF participation when allowing region fixed effects to vary over time indicates that time-varying differences between health regions are not a source of confounding in the GMF participation and reported access relationship.

Table 7.10 Additional models investigating the impact of GMF participation on reported access; models with interaction terms. Statistically significant results at α=0.05 are bolded.

	Coefficient on GMFpar terms in fully adjusted DD model for the outcome of having a regular medical doctor			
Model	**β**	**95% CI**		**N**
Year + Region + GMFpar1 + Year*GMFpar1 + covar				95370
GMFpar	0.14	-0.032	0.31	
GMFpar*2001 [A]	----	----	----	
GMFpar*2003 [B]	0	0	0	
GMFpar*2005	0.14	-0.032	0.31	
GMFpar*2007	0.15	-0.038	0.33	
GMFpar*2008	0.11	-0.073	0.29	
GMFpar*2009	0.066	-0.11	0.24	
GMFpar*2010 [C]	----	----	----	
Year + Region + GMFpar1 + Year*Region + covar				95370
GMFpar	-0.021	-0.15	0.11	

[A] *Year 2001 is the reference year.*
[B] *Coefficient is 0 because 2003 is a pre-implementation year.*
[C] *Coefficient is not reported for GMFpar*2010 because it is collinear with another level in the*

*GMFpar*Year interaction term.*
Share of physicians participating in the GMF model is the main exposure variable
Covariates include age, sex, ethnicity, marital status, household education, immigration status and length of stay in Canada, household income adequacy, language proficiency, sense of community belonging, geographic availability of health services, self-reported health status, and number of physician-diagnosed chronic health conditions

Finally, the placebo test (Table 7.11) on an outcome thought unlikely to be impacted by exposure to the GMF model, experiencing an injury in the last year, shows no significant effect of GMF participation in the fully adjusted DD model at -1.45 (-3.14, 0.24). A non-significant result suggests that the DD model is performing correctly by not finding a significant impact on an outcome that I substantively believe should not be affected by GMF participation levels. The majority of access outcome measures have had corresponding GMF participation impacts close to zero. While some of these have somewhat wide confidence intervals relative to their effect estimate size, my confidence intervals indicate a true null effect. By contrast, the coefficient on GMF participation for the placebo test is much larger and with a considerably wide confidence interval that gives us a null effect but without the same level of precision.

Table 7.11 Impact of GMF participation on placebo test of sustaining an injury in the past year in the fully adjusted DD model. Statistically significant results at α=0.05 are bolded.

	Coefficient on GMFpar in fully adjusted DD model for a placebo outcome			
Outcome	**β**	**95% CI**		**N**
Had an injury in the past year	-1.45	-3.14	0.24	95311

The fully adjusted DD model is Y=GMFpar + Year + Region + covar
Share of physicians participating in the GMF model is the main exposure variable
Covariates include age, sex, ethnicity, marital status, household education, immigration status and length of stay in Canada, household income adequacy, language proficiency, sense of community belonging, geographic availability of health services, self-reported health status, and number of physician-diagnosed chronic health conditions

8. Discussion

The standard difference-in-differences design uses a control and treatment group and a before-after contrast in an attempt to estimate the causal impact of a policy implementation on a chosen outcome of interest. This model can control for observed and unobserved confounding in the exposure-outcome relationship by taking overall time trends in the outcome and fixed differences between groups into account.

In my thesis, I investigated the causal impact of the implementation of GMFs, an inter-professional team-based model of primary health care, in Quebec on access to primary health care using the DD design. However, identifying an appropriate control group presented certain challenges. One study exploring the impact of a policy implementation in Ontario used other Canadian provinces where no such policy existed as the control group (Charters, 2011). However, using other provinces as a control group for my analysis was judged to be a poor option for several reasons. First, several other provinces in Canada either previously or concurrently implemented new system-wide integrated team-based models of primary health care delivery making them ineligible for the control group. Second, all other provinces and territories that did not implement team-based models in a system-wide fashion have had either smaller scale team-based programs or carried out related pilot or demonstration projects (Hutchison et al., 2011). Instead I chose to compare the impact of area-level changes in exposure to the GMF model within the health regions of Quebec. The variation I found in GMF participation among the regions (Figure 7.1-Figure 7.2) precluded the use of a standard difference-in-difference analysis because there is no distinct period of complete exposure to the GMF model and no ideal unexposed group in the GMF post-implementation period.

Accordingly, I modified the DD design to use a continuous measure of exposure to the GMF model that varies over time and by health region. I included year and region fixed effects to account for time trends in the outcome and fixed differences between regions, respectively; selected individual-level covariates were used to control for any observed time-varying differences between regions and to increase precision of effect estimates.

8.1 Testing assumptions

The three assumptions critical to the DD model are exchangeability of the treatment and control groups, exogeneity of the policy implementation, and continuing time trends in the outcome in the control and treatment groups in the absence of the policy.

8.1.1 Exchangeability

In examining exchangeability I have no clear treatment and control groups; instead I used physician GMF participation measured in 2004 to group the 15 health regions into quintiles of GMF participation; I then contrasted pre-implementation demographic, socioeconomic and other characteristics for regions in the lowest and highest quintiles. Table 7.1 presents the statistical comparison for selected variables and variable levels with the full table available in the appendix. Some important differences were evident between the highest and lowest GMF participation quintiles largely due to the presence of Montreal among the regions with the lowest participation rates. Montreal's metropolitan nature and large population size heavily skewed the direction of the bottom quintile's pooled estimates. The quintile differences were in expected places such as language proficiency where Montreal would have a much higher percent of English use; in immigration status given than Montreal has the largest population of immigrants in the province; and educational attainment and income adequacy category since Montreal is an important economic center in both Quebec and Canada and because Montreal comprises a large number of post-secondary institutions including four universities.

I repeated the above comparison under different conditions: recalculating quintiles based on GMF participation measured in 2011, and using patient GMF participation (proportion of the population enrolled in GMFs by region and year). Differences in the characteristics between the various conditions were minimal and explained entirely by the nature of the regions included in the comparisons. Finally, I compared quintiles where Montreal was excluded from the analysis with the next lowest participating region replacing Montreal in the bottom quintile. The differences between the highest and lowest quintiles shrank noticeably, but statistically significant differences were still observed in most of the same categories. Again, the

persistence of differences can be explained by the inherent characteristics of the regions included, which are controlled for in the regression analysis by the region fixed effects.

Interestingly, the highest quintile of participation, under all conditions, was composed of some of the more rural regions of Quebec while the lowest quintile consistently contained more populous and metropolitan regions. It may be the case that, in rural areas with dispersed population and resources, physicians may feel that operating as part of a team would be a more efficient use of resources whereas physicians in more urban and populous areas have a concentration of patients and resources and feel less need to work within a team. Second, Quebec's health ministry strongly encourages newly graduating physicians to practice in rural and remote regions, away from large urban centers. It may be that younger physicians are more enthusiastic about new models of health care and more likely to participate in the GMF model. The MSSS study of 2008 found that very early in implementation, GMFs had a higher proportion of physicians below the age of 50 than comparably sized non-GMF clinics in the same area but that this difference lessened in the following few years which somewhat contradicts my second proposed reason (Ministère de la santé et des services sociaux, 2008).

However, given that the variation in regional characteristics is principally related to geographic location and the presence of urban centers, these differences are likely to remain largely fixed over time. As such, I can compare the impact of GMFs on reported potential and realized access in health regions with low participation relative to regions of high participation with confidence that the fixed differences between these regions are taken into account by the region fixed effects in my regression models.

8.1.2 Exogeneity

The second assumption, that the policy under study is exogenous to changes in regional characteristics, means that the DD model assumes that the presence of the policy does not alter the composition of the treatment group, especially in ways that might have an impact on the outcome. To examine exogeneity of the policy implementation, I investigated whether regions of highest and lowest GMF participation experienced changes between 2001 pre-implementation and 2010 (late) post-implementation characteristics. I only examine

demographic, socioeconomic and population characteristics, and not outcome variables here as we expect those to change in response to the policy.

For some variables, significant changes between 2001 and 2010 occurred similarly in the lowest and highest quintiles; as they remain fixed over time, the year fixed effects term in my regression analyses will account for these common changes. Other differences between years were found only in one quintile and were largely related to existing trends of economic development and increasing educational attainment and immigration. More rural regions are likely to experience the impact of these trends in different ways than urbanized regions such as Montreal or mixed urban-rural regions like Montéregie. These known time-varying differences between regions can be controlled by including them in the regression model. I can also allow regional trends on access or confounders to vary differentially over time by including a year and region interaction term.

Considering a reverse causality scenario, if GMFs are created at a higher rate (implying GMF participation is greater) in regions where access to primary health care is particularly poor and perhaps worsening, then implementation of the policy is not exogenous to regional characteristics and our ability to estimate a causal effect is questionable. Recall that I showed how higher GMF participating regions are those that already have better reported access in the pre-implementation period (Figure 7.5) implying that GMF participation is, in fact, correlated with pre-period access levels. Though the policy is implemented across the whole of Quebec, it is taken up at different rates depending on the region and numerous other factors including physician and patient characteristics. However, it helps that pre-period access trends (if not levels) are similar as these fixed differences are controlled through region fixed effects. Ultimately, though pre-period access levels are correlated with GMF participation, I do not believe that pre-period access levels cause GMF participation.

8.1.3 Common trends

Looking at trends in the outcome of having a regular medical doctor, we can see in Figure 7.3 that there are differences in reported access by health region with some regions, such as Montreal (number 6), consistently reporting the lowest level of potential access to primary

health care in all of Quebec. The increase in reports of a regular medical doctor in most regions is reflected in the overall trend in reported access in Figure 7.4. The presence of a trend in the outcome is relevant to the interpretation of results because an analysis design that does not account for common variation over time may incorrectly attribute a significant change in the outcome solely to their exposure variable. The increasing trend in reported access across all regions will be controlled for in my analysis through the inclusion of the year fixed effects variable in my modified DD regression model. As a side note, I presented results only for the outcome of having a regular medical doctor; however, the other potential and realized access outcome variables, such as unmet health care needs and use of preventive services, followed similar patterns of slightly increasing access over time.

In the DD model, the most important assumption is that of common outcome trends in the treatment and control groups in the absence of policy implementation. Since recording the counterfactual outcome Y_{0i} in the treatment group is impossible, we instead look at the pre-policy period for evidence of common trends. Given that I have no official control group, I again compared the outcome trends in the highest and lowest GMF participation quintiles. Figure 7.5 shows the trend between 2001 and 2010 for the outcome of having a regular medical doctor plotted separately for the highest and lowest quintiles of 2004 GMF participation. The trends closely parallel each other before GMF policy implementation occurs, providing evidence to support the common trends assumption. In addition, the similar trajectories are maintained after implementation, which reflects the main finding that increases in GMF participation did not impact reported access measures.

Two important points can be taken from the absence of change between the trends following the implementation date. First, regions with higher participation are also those with better reported access but that this circumstance holds true both before and after GMFs were introduced. This finding provides early evidence for a lack of impact of GMF participation on reported access to primary health care. Importantly, a regression analysis that does not control for common time trends and fixed differences between regions would likely find a significant association between GMF participation and reported access as shown in Table 7.2. The second

interesting aspect is that, assuming for now that higher GMF participation does not cause increased reporting of potential access, then it is as if the 'treatment' group of highest GMF participation quintile was in fact unexposed to a policy and the common outcome trends assumption is further validated.

Anyone closely examining Figure 7.5 would note that the vertical line marking the policy implementation is found at year 2004 when in reality the GMF policy was introduced in November of 2002. This shift is due to how I matched the CCHS and GMF datasets, first, to have regional GMF exposure measurement precede outcome recording and, second, to account for the retrospective nature of most health care access related question in the CCHS (see section 4.2.1). The CCHS year 2004 with a theoretical look-back period of 2003 is assigned as the date of implementation.

In the Methods chapter, I discussed how, as a result of the assumptions regarding common trends in the outcome, the effect estimate from the DD model is assumed to be the only influence on the outcome given that the model can control for confounding through time trends in the outcome and fixed differences between regions. However, even all these measures cannot account for the impact of another policy present only in the treatment group that plausibly affects the same outcome of our study. A literature search is necessary to uncover any other policy or program that may potentially impact our outcome of interest. In Quebec, two such programs may have had an impact on access to primary health care. Importantly, early in 2003 an incentive program for physicians providing primary health was introduced to encourage enrollment of vulnerable patients – individuals with chronic conditions and/or those over age 75. A program incentivising enrollment of patients with physicians could reasonably increase the number of individuals reporting a regular medical doctor (as well as other improved access outcomes). The impact of this program on my effect estimate would depend on the regional level of participation. If high and low GMF participation regions also had, respectively, high and low use of the enrollment incentive then this might bias the estimated impact of GMF participation upwards. If low GMF-participating regions had high incentive use and vice versa for high GMF-regions, then the estimated impact of the GMF

model might be biased downwards. Finally, if use of the incentive program is fairly uniform across all regions, then year fixed effects in the regression model should account for its presence. For my largely null regression effect estimates to have been biased by the presence of the incentive program, it would have to have been a downward bias caused by high GMF regions having low vulnerable patient enrollment, an outcome unlikely as the age structures of most health regions show no significant differences. The other program introduced that might also impact access to primary health care are orphan patient registries that are meant to help individuals find a family doctor with a small incentive for physicians who enroll patients from the registries. However, these registries were only introduced in 2008, very late within my study period and are unlikely to have had a noticeable impact on reported access within that time (Breton et al., 2012).

Overall, I found that my data respects the DD assumptions, and that, given the structure of my modified DD model, I should be able to estimate a causal effect of GMF participation on various measures of access to primary health care.

8.2 DD regression analysis

8.2.1 Potential access: regular medical doctor

In Table 7.2 to Table 7.5, I present the coefficients on the GMF participation variable in various (linear and logistic) regression models demonstrating the evolution of my modified DD model. With only physician GMF participation in the model, a positive and significant correlation was found of a 0.097 (0.075, 0.12) percentage point increase in individuals with a regular medical doctor attributable to a one percentage point increase in GMF participation in the linear model; a 0.099 (0.076, 0.12) percentage point increase was found in the logistic model (Table 7.3). This effect estimate remains positive and significant when time trends in the outcome are taken into account by adding year fixed effects. However, the impact of GMF participation disappears and becomes non-significant when region fixed effects are added into the model. This shrinking of effects demonstrates that fixed differences between the health regions account almost entirely for the correlation between GMF participation and levels of access. In the final full model

including both fixed effects and covariates, I found a negative and non-significant change in reported access as GMF participation increased, -0.061 (-0.014, 0.022) percentage point change from the linear coefficient and -0.057 (-0.14, 0.024) percentage point change from the logistic average marginal effect. From Table 7.4, we can see that the same story holds when I use patient participation in GMFs as the main measure of exposure. Interestingly, when Montreal is removed from the analysis (Table 7.5), the simplest regression including only GMF participation produces a non-significant result. It appears that Montreal consistently being among the lowest participating regions paired with its consistently lowest reported level of access in Quebec contributes to producing a linear association between GMF participation and reported access. However, as I have shown in full sample models, region fixed effects account for fixed differences between regions, among which is Montreal's significantly lower level of reported access.

For the remainder of the results and discussion, I only refer to the effect of physician participation in the full sample analysis. In nearly every case the patient participation variable captures an equivalent result and the estimates for patient participation can be found in Appendix C: Results Part III: Regressions. In addition, I have shown that the linear model is a very close approximation of the logistic model's marginal effect estimates when the outcome is common and when the model is not predictive. Therefore, in cases of a common outcome, I will focus on linear regression estimates and logistic average marginal effect estimates otherwise.

I will now turn to a discussion of the null impact of GMF participation on individuals reporting a regular medical doctor when a specific GMF program goal was to provide all Quebecers with a family doctor. The GMF program essentially brought about the voluntary reorganization of primary health care physicians into multidisciplinary teams alongside nurses and administrative support staff. Nurses were to take on the provision of certain services, especially some forms of patient follow-up, and administrative staff would keep track of records, patient appointment and other general duties. In theory, with nurses providing some of the care that physicians had previously been responsible for, physician load per patient should be reduced meaning that each physician could now treat more patients. In addition, the lump sum payment per enrolled

patient per year should provide extra motivation for increasing the number of patients handled per FTE-physician.

However, I did not find the expected increase in proportion of the population reporting a regular medical doctor. Perhaps physician work load per patient has not been sufficiently reduced by nurses or that the enrollment incentive has not been enough to counterbalance the added work and responsibility for physicians to take on more patients. Signing a contract was found in the MSSS study to increase feelings of responsibility toward enrolled patients (Ministère de la santé et des services sociaux, 2008); as well, physicians reported spending more time than previously on each consultation and that they felt they could not provide an adequate and safe level of care to the MSSS-recommended number of patients per physician. Some early GMFs had more FTE-physicians than comparably sized non-GMF clinics because fewer GMF physicians self-identified as working part time in their clinic. But this was a study performed in a few GMFs early after the program was rolled out and cannot be extrapolated to all GMFs in all regions or that this situation was maintained in later years or in late GMF adopters. Recently, the MSSS has chastised GMF physicians for not enrolling their recommended number of patients and has cautioned GMFs about repercussions and possible future changes in GMF funding (Daoust-Boisvert, 2013).

8.2.2 Other potential access measures

For other potential access outcomes the DD model has also demonstrated a non-significant impact of GMF participation on reporting of unmet health care needs, difficulty accessing health information, routine care, and immediate care for minor health problems. The latter four outcome variables measure potential access in the opposite way as my main outcome of having a regular medical doctor. Instead of possessing the potential to access care, reporting unmet needs or difficulty accessing care demonstrates an individual's struggle or absence/lack of potential access. In the Variables chapter, I discussed how my different access measures represented different facets of accessing primary health care. Importantly individuals with a regular medical doctor – who, by one definition, have potential access to health care through this doctor – can also use the measures of unmet needs and difficulty accessing care to report a

deficiency in different facets of potential access. If participation in the GMF model were to have the expected impact of improving access to primary health care, I would anticipate significantly negative effects of GMF participation on unmet needs and difficulty accessing a given form of care, indicating a reduction in lack of potential access. These results provide further evidence for an absence of impact of GMF participation on potential access to primary health care.

Further investigating difficulty accessing certain forms of care also produced non-significant results for the impact of GMF participation on time of day the difficulty occurred (during regular hours, evenings or weekends, or the middle of the night). We would specifically expect a decrease in reported difficulty accessing care outside of usual clinic hours as GMF agreements with the MSSS always stipulate how and when certain after-hours services will be provided. Most early studies found that GMF patients reported improved access (usually over a two year follow-up) to care during the evenings or on the weekend, even though there was a measurable drop the number of GMFs offering after-hours care (Beaulieu et al., 2006; Ministère de la santé et des services sociaux, 2008; Tourigny et al., 2010). Later investigations by the MSSS have found that an ever increasing number of GMFs are not respecting their contracts to provide after-hours walk-in consultations (Daoust-Boisvert, 2013).

8.2.3 Realized access

The importance placed on preventive care was a critical component of proposed health care reform that sought to steer Canadian health care away from the standard emphasis on treating health problems as they arise (Romanow, 2002). Even though a primary health care physician may not provide a flu shot or Pap test and most definitely not a mammogram, under new models of integrated and coordinated care, they should be counselling patients on the appropriate use of preventive care and screening methods as well as following up with patients and communicating with providers of the recommended service. As with my other access measures so far, the influence of GMF participation on the appropriate receipt of preventive services was non-significant and very close to the null hypothesis of no effect. Only for receiving a mammogram within the past two years among women 35 years and older was there a significantly negative impact of -0.24 (-0.45, -0.032) percentage point change for a one

percentage point increase in GMF participation. A non-significant result was found when the sample was restricted to women 50 years and over, the age at which Canadian guidelines recommend women begin breast cancer screening, as well as when restricting to women 35-49. Qualitatively, the impact of GMF participation on receipt of a mammogram for the latter two sample restrictions is similar to the statistically significant finding for women 35 years and older. However, the decreased sample size may be responsible for the loss of significance when examining specific portions of the sample. Alternatively, we should consider the potential for type I error to produce falsely significant effects. With $\alpha=0.05$, we can expect, on average, five incorrect rejections of the null hypothesis out of one hundred regression analyses. Given the large number of outcomes that I have examined under multiple conditions, it is not surprising to find a few significant results among largely non-significant effect estimates.

8.2.4 Barriers

As we saw in the results, different types of access measures are more likely to have different barriers reported than others. For not having a regular medical doctor, the most reported barrier is geographic availability which increases between 2003 and 2010; personal barriers were also cited at a significant rate, though the latter decreased between 2003 and 2010. Time barriers were the most important according to individuals with self-perceived unmet health care needs, though other barriers were reported as well. For individuals not receiving a flu shot, nearly all reported personal and other barriers. For Pap test and mammogram, a smaller majority of individuals not receiving these services reported personal reasons along with an important proportion reporting other barriers.

In the case of not having a regular medical doctor, it could perhaps be argued that the high reporting of geographic availability barriers is a result of the high proportion of reasons proposed to each respondent (3 of 5) being combined into that one category (see Appendix A Table A–1). The same argument could be applied to the very high reporting of personal barriers for not receiving a flu shot, Pap test or mammogram. In the latter case, roughly half the possible reasons fall into the personal barriers category. However, it is important to note that for the above realized access measures, there was also very high selection of the other barriers

category that is a combination of many fewer possible reasons. Similarly, for individuals with unmet health care needs, the most important barrier identified was that relating to time. The time barriers category included only two of the sixteen proposed reasons. Given that I found high reporting of barrier categories composed of a minority of possible options, I feel that such a high percentage of eligible respondents choosing geographic barriers for not having a regular medical doctor or personal barriers for not receiving the appropriate preventive service is not unduly biased by the manner in which the categories were constructed. Especially in the case of personal barriers, while the reasons may differ widely between not knowing where to go to obtain the service, being too busy, and being too afraid to obtain it, these all signal an underlying general lack of information: lack of information on obtaining a service, and lack of information on the importance of obtaining a service that might encourage individuals to conquer their fears or to set time aside for valuable medical care.

From the comparison of highest and lowest GMF participation quintiles we can see that more individuals in the highest quintile identify geographical barriers when it comes to not having a regular medical doctor and unmet health care needs, though for the latter this difference is gone by 2010. I previously discussed how the lowest GMF participation quintile includes Montreal and other regions with important levels of urbanization; while the highest quintile is made up of much more rural environments, further from the influence of large urban centers. It makes sense that, in a densely populated region such as Montreal, the geographic distance to a medical doctor may not be the problem, while finding one within an appropriate distance to accept patients is likely the greater issue. By contrast, more rural regions will likely suffer more from geographical distance and (potentially) similarly in insufficiency of doctors accepting patients. Both these concepts are included as separate reasons in the geographic availability barrier for regular medical doctor and I believe this is a possible explanation for why geographic barriers are more reported in the highest GMF participation quintile than in the lowest.

With this simple descriptive analysis of self-reported access barriers, it seems as though a lack of primary health care physicians, in general or accepting new patients, is an important obstacle to having a regular medical doctor. Efforts to promote family medicine as a residency option

among medical students have been largely successful in recent years, and will hopefully continue to contribute to an increasing number of practicing family physicians in Quebec. Other initiatives might take the form of encouraging, or requiring, GMF participating physicians to accept more patients, and prioritizing the dissemination of information to Quebec residents on finding a family doctor.

Given that unmet health care needs is the most general measure of access in my study I expected a range of access barriers to be reported as respondents will identify the barriers most relevant to their particular access problem. It was therefore interesting that while there were an important percentage of respondents with unmet needs citing geographic availability, personal and other barriers, time barriers stood above the rest. Unfortunately, it is difficult to draw any specific implications from this data beyond that, in general, individuals with self-perceived unmet health care needs tend to see wait times and timing issues as the greatest barrier to accessing their perceived needed care.

In terms of preventive services, it is not unexpected that personal barriers are so highly reported. Many individuals may not perceive the seasonal flu shot as necessary either because they do not work in environments which pre-dispose them to influenza exposure or because they do not perceive infection as detrimental to their state of health or that of loved ones. Others may fear vaccination or feel that time or energy spent obtaining the flu shot outweighs its benefits in the face of perceived likelihood of becoming ill. For Pap test and mammogram, more common personal reasons likely include fear of the service, dislike of the procedure, putting off the procedure to avoid the experience or potentially concerning results. For all three of these preventive services having a family doctor to encourage their appropriate use is a great advantage. Appendix Table C–6 breaks down the receipt of preventive services to the recommended age groups for those with and without and regular medical doctor for all years of my study and averaged across all health regions. A higher proportion of each health service's target group among those with a regular doctor received the service compared to those without. These results are in line with other studies on receipt of preventive services (Blewett et al., 2008; Ferrante, Balasubramanian, Hudson, & Crabtree, 2010; Flocke et al., 1998; Pandhi

et al., 2011; Xu, 2002). While my DD regression results indicate that an increase in patient participation in the GMF model did not result in an increase in reported access to preventive care, I believe this is due to, as I discussed above, physicians joining (or founding) a GMF and formally enrolling their current roster of patients without accepting more. Therefore, I believe that continued efforts to enroll patients with physicians and to increase the number of individuals with a family doctor will contribute to better receipt of appropriate preventive services. In addition, patient resistance or indifference to receiving these forms of care should continue to be targeted through information campaigns stressing the importance of preventive care. Finally, the use of electronic medical records that better track patients records and provide timed reminders for physicians have a great potential to aid physicians in ensuring their patients receive the right service within the appropriate time frame.

8.2.5 Extra checks on the DD model

A few extra checks for my full DD model include the (separate) inclusions of two interaction terms and a placebo test. Given that I have found a null impact of GMF participation on nearly every measure of access in my study, I investigated how GMF participation impacted reported access over time by including a GMF participation and year fixed effects interaction term. I found no significant GMF participation-year interactions indicating that there was never any impact of GMF participation on reported access (in this case, having a regular medical doctor) early, mid or late in GMF implementation. Next, I interacted region fixed effects and a linear year variable to allow the regional impact on reported access to vary over time. The coefficient on GMF participation remains non-significant and close to the null at -0.021 (-0.15, 0.11) percentage point change in reporting of having a regular medical doctor for a one percentage point increase in GMF participation. This result is very similar to my DD model without interaction indicating that time-varying confounders do not appear to have impacted estimated effects of GMF participation on reported access.

Finally, the placebo test is meant to verify the model's performance in a situation where you expect a null result; a significant placebo result would weaken the causal implication of a significant result on any outcomes of interest. Various methods exist for placebo testing but

here I used a placebo outcome – one which I substantively believe should not be impacted by exposure to the GMF model. Reporting an injury in the last year should not be influenced by regional GMF participation and indeed I find no significant effect. In this case the ability of my DD model to produce a non-significant effect for a placebo test supports its ability to detect true null effects.

8.2.6 Overall

Even without clustering of standard errors or other variance estimation techniques recommended for DD models, the majority of effect estimates for GMF participation on reported access are non-significant. Given that these techniques generally widen confidence intervals compared to standard variance estimation, the application of special variance estimation would be unlikely to change the interpretations I have drawn from my models.

8.3 Limitations

Several limitations were inherent in the data available and the design of my study. However, I attempted to address or test each limitation in order to evaluate its potential for influencing the results of my study.

My measures of access are generally not uniquely related to primary health care but for each access measure a strong argument can be made for its relevance in the context of primary health care. For example, a regular medical doctor is not specifically a family doctor but it is a physician with whom the patient has a longitudinal relationship and from whom the patient presumably receives the majority of their care, two important attributes of primary health care. In addition, my access measures do not directly measure the impact of a lack of perceived access on health outcomes meaning I cannot complete the entire access story from potential access to realized access to health outcomes. However, the access measures I selected are accepted indicators of health system performance and were chosen to test specific program goals, theoretical access-related features of integrated team-based models of primary health care, as well as different definitions of access to health care in order to produce as comprehensive a picture as possible.

In terms of my exposure, I could only measure area-level exposure, and could not identify individuals from the CCHS who were enrolled in GMFs. Some might argue that I cannot demonstrate that my area-level exposure measure is applicable to the sampled individuals in my study because the exposure and outcome data arise from different sources. The CCHS is a survey designed to be representative of the Canadian, Quebec, and health region populations. It therefore seems unlikely, given that GMF participation is measured at the health region level, that respondents of the CCHS would be unrepresentative of a region's level of GMF participation. I believe that, by the design of the CCHS and my definitions of GMF participation, I have appropriately matched area-level GMF exposure to CCHS respondents.

In terms of general appropriateness, area-level exposure works well for some research questions – such as testing the program goal of providing all Quebecers with a family doctor. The latter is a population level goal and it is appropriate to study at area level. However, other goals such as increasing appropriate use of preventive services or improving access to primary health care outside of regular clinic hours may have been more directed towards patients enrolled in GMFs. However, by the end of my study the highest participating regions had roughly half or more of their primary health care physicians and half of their populations participating in the GMF model. Even regions in the lowest participation quintile had a quarter to one third of primary health care physicians, and around a quarter of their populations in GMFs. Therefore, if GMFs were to have a population impact on provision of preventive services or access outside of usual hours I should be able to capture an effect through GMF participation because I have a wide range of participation values for most health regions. Importantly, individual GMF participation status for both physicians and patients is likely confounded, as shown by Coyle; therefore using individual participation status would not afford convincing causal effect estimates for the effects of GMF enrollment (Coyle, 2011).

Testing the DD assumptions was difficult because I employ a continuous measure of GMF exposure and have no identified control and treatment groups. I chose to compare relatively high participating regions against relatively low participating regions with the hope that comparing the extremes of participation would most closely approximate a situation with

treatment and control groups. To validate the results from my assumption testing with highest and lowest GMF participation quintiles, I used various conditions to produce the quintiles and examined the resulting comparisons. I developed two measured of GMF participation – participation by physicians and participation by patients. I chose two different post-implementation years to produce the GMF participation quintiles: 2004, early in implementation and 2011, late in implementation. Finally I performed the analyses with and without the Montreal health region included in the sample. Combining these conditions produced eight separate quintiles from which arose very similar comparisons. The largest differences occurred in the pre-implementation characteristic comparison when Montreal was removed from the sample. These results were not unexpected and, importantly, the absence of Montreal merely reduced the degree of difference between the highest and lowest quintiles, while the statistical differences remained. Similar results obtained under many different conditions offers support for my use of highest and lowest quintiles in assumption testing.

In my regression analysis I was unable to apply recommended variance estimation procedures due to the CCHS requirement of bootstrap variance estimation. However, bootstrap weights are based on the CCHS sampling design that uses health regions as some form of clustering; in addition bootstrap weights are also calculated for each year so we can plausibly argue that the bootstrap variance captures some amount of the health region/year variance clustering. Also, as discussed above, application of the recommended variance estimation techniques would likely only serve to widen the confidence intervals without affecting the conclusions drawn from the results as the average treatment effect estimates for GMF participation are already largely null.

Some small limitations from my regression analyses include small sample sizes on some outcomes because of skip patterns or initial sample sizes; these smaller sample sizes often lead to a loss of precision from wide confidence intervals that make interpretation of the effect estimate more complicated. It is difficult to recover from such an issue; however, most estimates from small sample size regressions I ran remained close to the null with simply wider confidence intervals than other estimates. In addition, several of my access outcomes were

recorded in only two of my study's post-implementation years making it somewhat more difficult to examine outcome trends and GMF impact by year than for other outcomes with four or five years of post-implementation data.

The presence of another program in Quebec that offers remuneration incentives to primary health care physicians for enrolling vulnerable patients could have reduced the impact of the GMF incentive for enrolling each patient. However, I would expect use of the vulnerable patient incentive to be distributed fairly evenly between health regions as participation in the program involves minimal effort or change for the physician, such as is required for participation in a GMF. Additionally, vulnerable patients are those with chronic conditions and/or those over age 75. The age structure and distribution of chronic conditions are quite similar among Quebec health regions; consequently, we wouldn't expect greater participation in one region based on availability of vulnerable patients to enroll. Therefore, it is unlikely that this extra program would have biased effect estimates for GMF participation as year and region fixed effects should have accounted for the influence of this program on access if its usage was relatively uniform across Quebec health regions and not varying over time in the same fashion as GMF participation.

Finally, it should be noted that while I have controlled for many potential confounders in the relationship between implementation of the GMF policy and reported access to primary health care, including fixed characteristics of health regions and common time trends, there remains the possibility of bias arising from unmeasured time-varying confounders. Such a bias could compromise the causal interpretation of my effect estimates. For example, any impacts of some other policy that is changing in the same way over time and space as GMF participation would be included in the coefficient interpreted as the GMF effect. Most potential confounding candidates of regional GMF participation on reported access are regional characteristics, time trends, and observed variables known to confound this relationship, all of which I control for in my analysis. Nevertheless, I must allow that unmeasured time-varying confounding is a possibility, however remote.

8.4 Strengths

My study investigates the longitudinal population impact of Quebec's GMF program on access to primary health care. Studies to date on GMFs have covered short periods of time mainly early within program implementation and/or involving a small number of GMFs within one or two of the larger health regions. Additionally, all such studies have focused on access for patients within the GMF and have completely failed to consider the impact of GMFs on individuals outside of GMFs, especially those who do not have a family doctor.

The multiple measures of access I employ in my analyses reflect a variety of definitions and facets of access to health care including potential and realized access, the presence and absence of access, and barriers to access. While not all measures are inherently specific to primary health care, all contribute to the overall pictures of access to primary health care. Having a regular medical doctor can be used as an indicator of a longitudinal relationship with a physician, a key element of primary health care and an important measure of potential access. Reporting unmet health care needs indicates having sought out and been unsuccessful in the search for care; this type of care may not only be primary health care but it is a measure of a lack of potential that can be reported by individuals with or without a regular doctor. Difficulty accessing certain forms of care is another measure for a lack of potential access that is available to any individual; and the types of care – access to health information, routine or on-going care, and immediate care for minor health problems – all fall mainly within the sphere of primary health care services. Provision of preventive health services is another important component of primary health care; even if a general practitioner does not provide a mammogram or a Pap test directly, they should be encouraging their appropriate use and coordinating the delivery of this care.

My regional GMF exposure measures – the proportion of primary health care physicians practicing within GMFs and the proportion of the population enrolled as patients in GMFs – are based on GMF administrative data and are an accurate portrayal of regional participation over time. Because CCHS sampling and corresponding weights are meant to be representative of

populations down to the health region level, the regional GMF exposure measure should correspond well to the average individual level of exposure in the weighted CCHS sample.

Even though I used a modified version of the DD model that does not specifically utilize the before-after and control-treatment contrast, my use of a continuous measure of GMF participation in conjunction with region fixed effects and year fixed effects ensures that I control the same elements as a DD model – unobserved confounding from common outcome trends and fixed differences between regions – and estimate a causal effect of GMF participation on reported access to primary health care.

8.5 Conclusions

GMFs are an integrated team-based model of primary health care and were introduced at the end of 2002 in Quebec with specific program goals (among others) of providing all Quebecers with a family doctor, and improving access to primary health care in general and especially outside of regular clinic hours. Investigating how access to primary health care has been impacted by the introduction and expansion of the GMF model in Quebec contributes to the understanding of the GMF program's overall performance, impact, and success is reaching its program goals. Natural experiments and quasi-experimental study designs, which allow us to investigate the impact of the implementation of a policy at a given time and in a given region, can provide greater confidence in estimating impacts of the policy because their use can control for trends over time, differences between groups, and unobserved confounding in the outcome-exposure relationship that might bias estimates obtained from standard observational studies.

My thesis project has been devoted to studying the impact of GMFs on access to primary health including the program goals listed above but also using a variety of definitions and concepts used in analysis of access to health care. Potential access – the ability to obtain care when needed – was a very important component of my study and I used several access measures to capture this concept including having a regular medical doctor, reporting unmet health care needs, and reporting difficulty accessing certain forms of care. I also investigated realized

access – actual use of health care – through the provision of preventive care services. I chose to measure receipt of preventive care because an emphasis has, since the advent of Canadian primary health care reform, been placed on prioritizing preventive care and because team-based models of primary health care are meant to emphasize coordination and comprehensiveness of care as well as whole-person care. Finally, I investigated reported barriers to accessing care and how they changed in response to GMF implementation.

To isolate a causal impact of GMFs on reported access to primary health care I produced a double fixed-effects regression model based on the difference-in-differences (DD) design that used my continuous measure of GMF participation along with year and health region fixed effects and my control variables. My modified DD model controlled for unobserved confounding through common time trends in the outcome and fixed differences between regions and allowed me to estimate the average treatment effect for a one percentage point increase in GMF participation on reported access to primary health care. I validated the use of this regression model with my data by testing DD design assumptions, a placebo test, other models including interaction terms, and under various conditions.

My effect estimates for GMF participation on most outcome measures that represent the different concepts and definitions of access to primary health care were generally close to zero and not statistically significant. The consistency of my results across outcomes makes a strong case for a null average treatment effect of GMF participation on both potential and realized access to primary health care. Specifically, although the proportion of the population reporting a regular medical doctor grew between 2001 and 2010 across all of Quebec, I found no increase attributable to greater GMF participation. Other potential access measures operationalized through a lack or absence of potential access did not improve as GMF participation increased. Similarly, potential access during regular hours did not demonstrate any change due to increased GMF participation, nor did reported after-hours potential access despite GMF contract requirements to provide after-hours access to information and consultation.

For realized access, some measures of access showed a very small significant change; however, the significance was not maintained with different GMF participation measures or when

restricting the sample to the specific preventive service target population. Overall, I found no support for an increase in the appropriate uptake of preventive services in conjunction with increased GMF participation. Similarly, I found no change in reporting of access barriers due to increase in GMF participation. The few exceptions were for increased reporting of personal barriers to accessing care due to a one percentage point increase in GMF participation.

One potential explanation for my results is that reorganization of solo practices, groups of physicians and public clinics into GMFs did not involve a concomitant increase in accepting new patients. It has been documented that many GMFs have not been respecting their agreements with the MSSS to provide after-hours care. Many studies cite an increase in access with a concurrent decrease in coordination of care; while I found no betterment of access to care in general, a lack of care coordination may explain why there was little change in provision of preventive services.

My investigation of access barriers for different access experiences allowed me to understand some of the obstacles that individuals faced when attempting to access health care. For individuals without a regular medical doctor, issues with geographic availability, including proximity of doctors accepting patients, were the most important barriers even in densely populated urban areas. Efforts to increase the number of family physicians practicing in Quebec and to incentivize or require enrollment quotas per GMF participating physician might contribute to alleviating these barriers. Individuals with unmet health care needs reported time barriers the most. It is difficult to conclude much from these results and it would be interesting to examine the type of care not being received and to link the latter to reason(s) cited for not receiving it to further investigate why temporal barriers are being reported at such a high rate for those with unmet needs. In terms of preventive services, personal and other barriers were the most important obstacles to access. Ensuring that more individuals have a family doctor is one way of improving appropriate use of preventive services; other means include introducing the use of electronic medical records and targeted information campaigns that provide information on where and how to receive a health care service and what health benefits arise from its use.

Overall, access to primary health care in Quebec remains a challenge and Quebec's primary health care reform through the GMF program does not appear to have impacted access at a population level. Other policy initiatives that target geographic distribution of GMF clinics, increasing the number of primary health care physicians, reducing wait times, and emphasizing and/or incentivising preventive service delivery should be considered for improving potential and realized access to primary health care in Quebec. Finally, it is vitally important that continued attention be given to evaluating policy reforms as these studies will help us measure and understand whether policy goals are being met and inform us about future directions in policy development.

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Appendix A: Variables

Table A–1 Reasons included in the categories of access barriers for various potential and realized access measures.

	Categorizing the CCHS reasons for not obtaining a service based on definitions of access barriers.	
Access measure	**Category**	**Reasons**
Regular medical doctor	Geographic availability	No medical doctors available in the area Medical doctors in the area aren't taking new patients Had a medical doctor who left or retired
	Personal barriers	Have not tried to contact one
	Other	Other
Unmet health care need	Geographic availability	Care not available in area Transportation problems
	Timing barriers	Not available at time required Waiting time too long
	Financial barriers	Cost
	Personal barriers	Did not know where to go Have not gotten around to it Felt it would be inadequate Decided not to seek care Too busy Dislikes doctors / afraid Unable to leave house Personal of family responsibilities Language problems
	Other	Doctor did not think it was necessary Other
Flu shot	Geographic availability	Not available in the area Transportation problems
	Timing barriers	Not available at the time required Waiting time was too long
	Financial barriers	Cost
	Personal barriers	Did not know where to go Have not gotten around to it Respondent did not think it was necessary Fear Bad reaction to previous shot Unable to leave the house Personal or family responsibilities Language problems
	Other	Other Doctor did not think it was necessary
Pap test	Geographic availability	Not available in the area Transportation problems
	Timing barriers	Not available at the time required Waiting time was too long

	Financial barriers	Cost
	Personal barriers	Did not know where to go Have not gotten around to it Respondent did not think it was necessary Fear Hate/dislikes having one done Unable to leave the house Personal or family responsibilities Language problems
	Other	Other Doctor did not think it was necessary
Mammogram	Geographic availability	Not available in the area Transportation problems
	Timing barriers	Not available at the time required Waiting time was too long
	Financial barriers	Cost
	Personal barriers	Did not know where to go Have not gotten around to it Respondent did not think it was necessary Fear Hate/dislikes having one done Unable to leave the house Personal or family responsibilities Language problems
	Other	Other Doctor did not think it was necessary

Table A–2 Definitions for the levels of the household income adequacy variable based on gross income from all sources and number of people per household.

INCOME	**Category definitions for the household income adequacy control variable**
Low	[0-10k[for 1-4 people [0-15k[for 5 or more people
Low-middle	[10-15k[for 1-2 people [10-20k[for 3-4 people [15-30k[for 5 or more people
Middle	[15-30k[for 1-2 people [20-40k[for 3-4 people [30-60k[for 5 or more people
Middle-high	[30-60k[for 1-2 people [40-80k[for 3-4 people [60-80k[for 5 or more people
High	[60k,∞[for 1-2 people [80k,∞[for 3 or more people

Table A–3 Definitions for the levels of the geographic accessibility variable obtained from Gauthier et al., 2009 based on census sub-division (CSD) of residence and travel times to large urban centers and different forms of health care.

GEOG	Category definitions for the geographic accessibility of health care control variable
Large center	CSD belonging to an urban core of more than 500,000 inhabitants
Sub-speciality center	CSD within 30 minutes of at least one tertiary care hospital
Peripheral specialized center	CSD within 30 minutes of at least one secondary care hospital and 2.5 hours or less away from an urban core of more than 500,000 inhabitants
Regional specialized center	CSD within 30 minutes of at least one secondary hospital and more than 2.5 hours away from an urban core of more than 500,000 inhabitants
Peripheral rural area	CSD situated 2.5 hours or less away from an urban core of more than 500,000 inhabitants
Intermediate rural area	CSD situated more than 2.5 hours away from an urban core of more than 500,000 inhabitants and less than 1.5 hours away from a hospital secondary or tertiary care
Remote rural area	CSD situated more than 2.5 hours away from an urban core of more than 500,000 inhabitants and between 1.5 and 3.5 hours away from a secondary or tertiary care hospital
Isolated rural area	CSD situated more than 2.5 hours away from an urban core of more than 500,000 inhabitants and more than 3.5 hours away from a secondary or tertiary care hospital

Table A–4 Common set of chronic conditions from the seven CCHS cycles included in my analysis.

	Common set of 15 chronic conditions included in the chronic3 control variable
Chronic3	Asthma, arthritis/rheumatism, back problems (not including fibromyalgia), high blood pressure, migraines, emphysema, chronic obstructive pulmonary disorder, diabetes, heart disease, cancer (past or present), ulcers, stroke, incontinence, bowel disease/Chrohn's disease, Alzheimer or dementia

Appendix B: Methods

This syntax for applying bootstrap variance estimation to marginal effect estimates from logistic regression models is based on the svy: postestimation page in the Stata 13 manual.

```
program drop _all

program mymargins, eclass
1.    version 12
2.    syntax anything [if] [iw pw]
3.    if "`weight'" != "" {
4.    local wgtexp "[`weight' `exp']"
5.    }
6.    set buildfvinfo on
7.    `anything' `if' `wgtexp'
8.    margins, dydx(*) post
9.    end

local mycmdline logit meddoc year rss gmfpar1
quietly mymargins `mycmdline'
svy bootstrap _b: mymargins `mycmdline'
```

program named mymargins

Run once at beginning of Stata session

Stata margins command with dydx option specifically chosen for estimating marginal effects of continuous variables

local macro containing the model you want to run

mymargins program applied to the local macro

Run for each regression

bootstrap variance estimation on the marginal estimates for the local macro

Appendix C: Results

Part I: Maps

Physician GMF participation

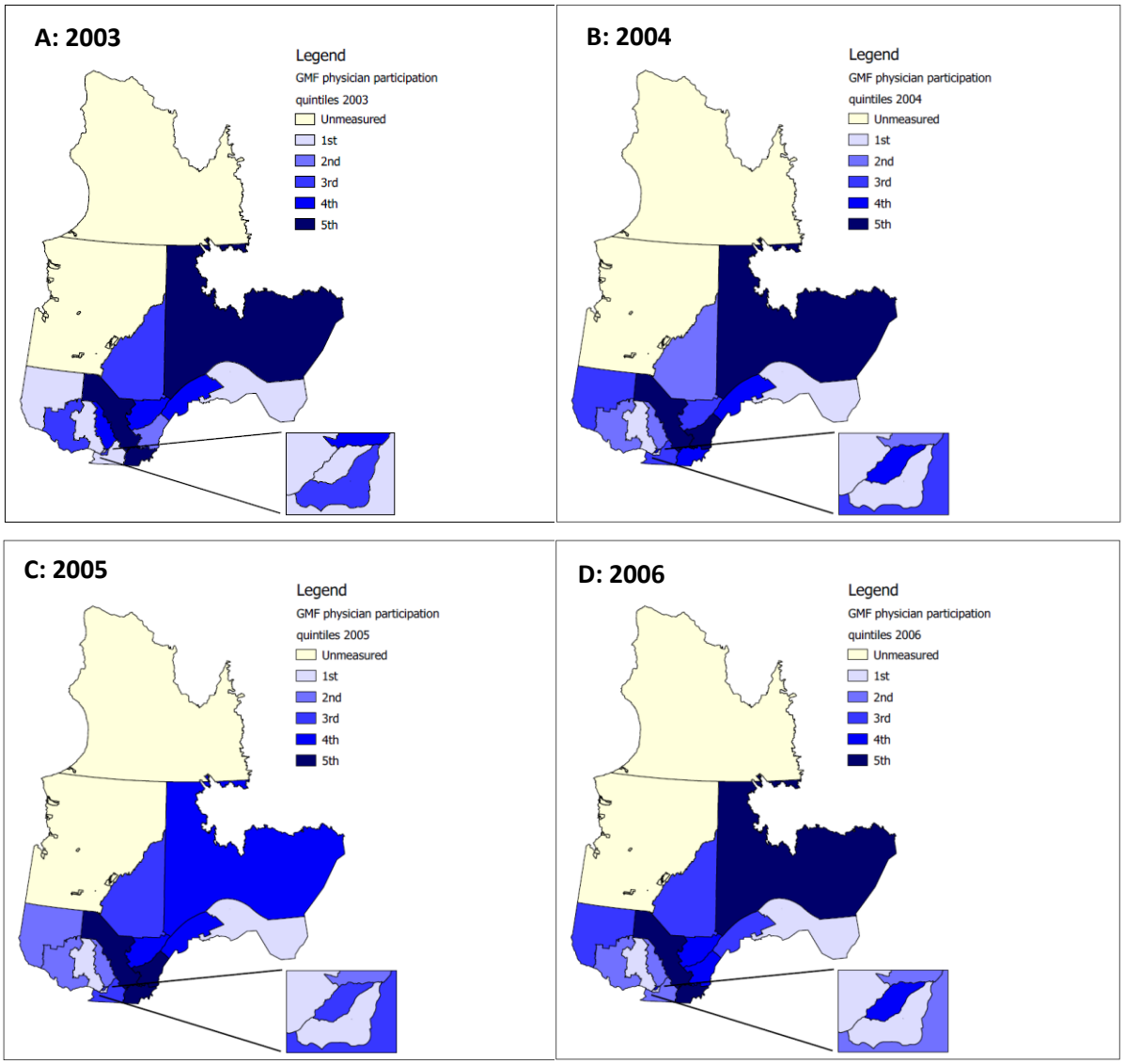

Figure C.1 Part 1 of maps of Quebec health regions categorized into quintiles of physician GMF participation. Part 1 shows physician GMF participation from years 2003 to 2006. The lightest blue indicates lowest participation while the darkest blue indicates the highest participation. Beige health regions are those where GMF participation was not measurable.

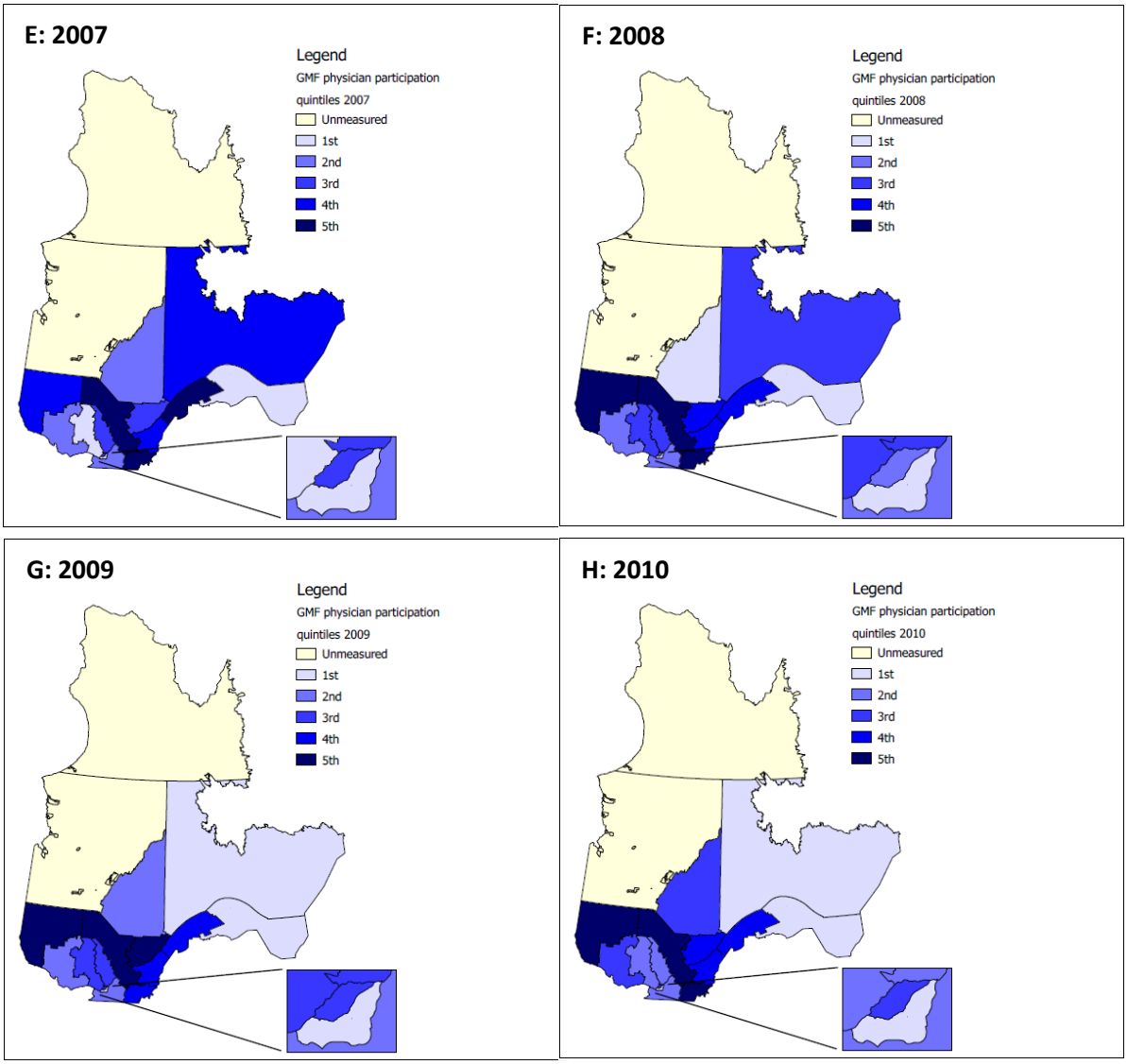

Figure C.2 Part 2 of maps of Quebec health regions categorized into quintiles of physician GMF participation. Part 2 shows physician GMF participation from years 2007 to 2010. The lightest blue indicates lowest participation while the darkest blue indicates the highest participation. Beige health regions are those where GMF participation was not measurable.

Patient GMF participation

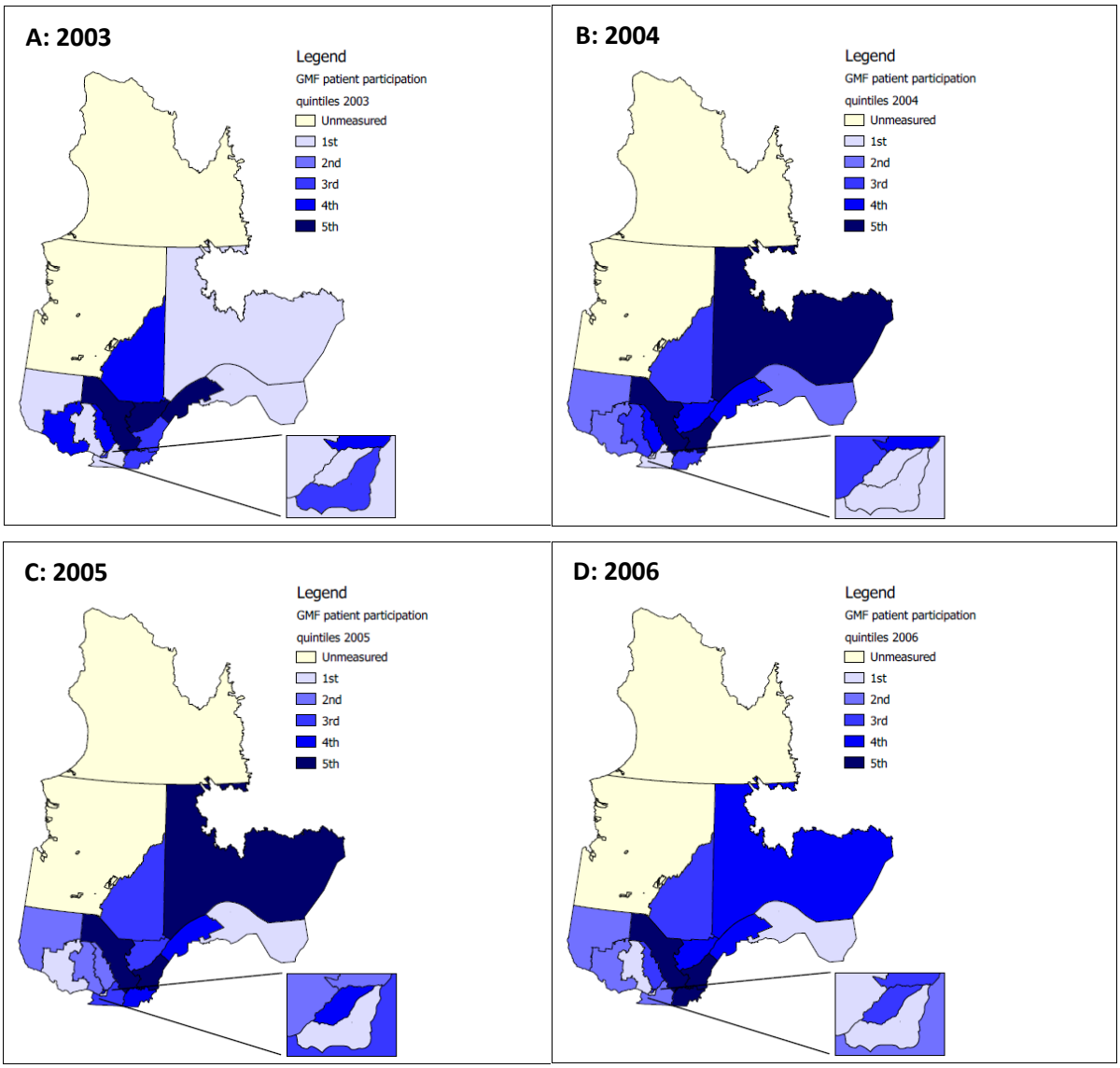

Figure C.3 Part 1 of maps of Quebec health regions categorized into quintiles of patient GMF participation. Part 1 shows patient GMF participation from years 2003 to 2006. The lightest blue indicates lowest participation while the darkest blue indicates the highest participation. Beige health regions are those where GMF participation was not measurable.

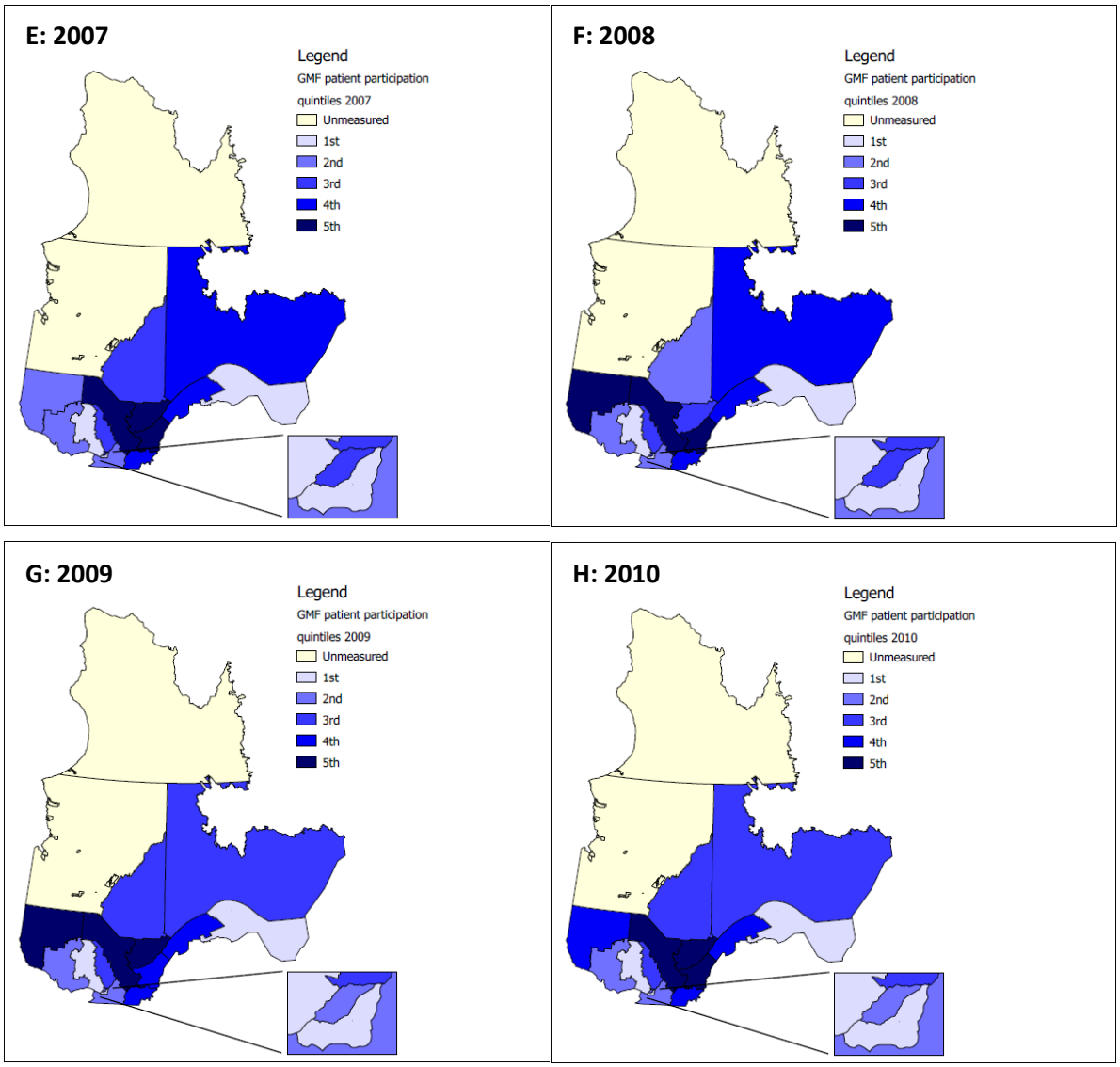

Figure C.4 Part 2 of maps of Quebec health regions categorized into quintiles of patient GMF participation. Part 2 shows patient GMF participation from years 2007 to 2010. The lightest blue indicates lowest participation while the darkest blue indicates the highest participation. Beige health regions are those where GMF participation was not measurable.

Part II: Descriptives

Pre-implementation characteristics

Table C–1 Pre-implementation characteristics for regions in the highest and lowest GMF participation quintiles as measured in 2004 and 2011.

CCHS 1.1 (2001)	Pre-implementation characteristics of regions with lowest and highest quintiles of GMF participation			
	2004		2011	
	Q1	Q5	Q1	Q5
AGE	45.65 (45.41-45.88)	45.66 (45.40-45.91)	45.73 (45.47-46.00)	45.86 (45.57-46.14)
SEX				
Female	51.63 (51.38-51.87)	50.22 (49.89-50.55)	51.75 (51.48-52.02)	50.73 (50.46-51.01)
Male	48.37 (48.13-48.62)	49.78 (48.45-50.11)	48.25 (47.98-48.52)	49.27 (48.99-49.54)
ETHNICITY				
Visible minority	15.54 (13.68-17.41)	0.97 (0.47-1.46)	18.08 (15.89-20.28)	1.39 (0.78-2.00)
White	83.33 (81.41-85.25)	98.51 (97.89-99.14)	80.95 (78.70-83.20)	97.97 (97.23-98.71)
Missing	1.13 (0.72-1.54)	0.52 (0.19-0.85)	0.96 (0.53-1.40)	0.64 (0.28-1.00)
GEOGRAPHY				
Rural	7.54 (6.30-8.77)	34.27 (29.86-38.69)	4.99 (4.44-5.55)	33.10 (28.99-37.22)
Urban	92.46 (91.23-93.70)	65.73 (61.31-70.13)	95.00 (94.45-95.56)	66.90 (62.78-71.01)
GEO AVAIL CAT				
Large center	80.50 (79.32-81.68)	15.37 (13.06-17.68)	90.77 (90.67-90.85)	----
Subspec center	3.77 (2.45-5.09)	18.85 (16.04-21.66	----	41.49 (37.18-45.80)
Periph spec center	8.22 (6.65-9.79)	31.77 (27.20-36.34)	----	21.76 (17.24-26.28)
Reg spec center	1.16 (0.84-1.48)	4.72 (3.79-5.65)	3.55 (2.98-4.13)	9.46 (7.98-10.94)
Periph rural zone	1.99 (1.21-2.77)	23.14 (18.33-27.95)	----	19.65 (14.81-24.49)
Intermed rural zone	0.88 (0.55-1.21)	2.60 (1.91-3.29)	2.24 (1.72-2.75)	3.75 (2.30-5.20)
Remote rural zone	3.48 (2.77-4.19)	1.32 (0.99-1.65)	2.64 (2.24-3.03)	3.38 (2.44-4.31)
Isolated rural zone	----	2.22 (1.47-2.98)	0.80 (0.41-1.20)	0.51 (-0.47-1.49)
MARITAL STATUS				
Married	42.95 (41.02-44.88)	41.81 (39.86-43.76)	42.71 (40.59-44.82)	42.65 (40.50-44.81)
Common-Law	14.39 (13.08-15.71)	20.12 (18.44-21.80)	12.80 (11.45-14.14)	19.89 (18.20-21.58)

Widowed	7.47 (6.76-8.17)	5.71 (4.97-6.46)	7.61 (6.83-8.39)	5.80 (5.07-6.54)
Separated	2.78 (2.30-3.26)	2.23 (1.71-2.75)	2.81 (2.27-3.35)	2.18 (1.65-2.71)
Divorced	6.37 (5.56-7.18)	5.94 (4.97-6.92)	6.38 (5.49-7.27)	6.59 (5.52-7.66)
Single	26.04 (24.58-27.49)	24.18 (22.20-26.12)	27.70 (26.15-29.25)	22.88 (21.10-24.66)
INCOME ADEQUACY				
Low	5.15 (4.38-5.93)	4.98 (4.09-5.86)	5.60 (4.72-6.48)	4.61 (3.82-5.39)
Low-Middle	10.27 (9.08-11.45)	8.45 (7.24-9.65)	10.54 (9.22-11.85)	8.11 (6.99-9.23)
Middle	22.42 (20.98-23.87)	28.20 (26.15-30.25)	23.39 (21.75-25.03)	27.54 (25.31-29.78)
Middle-High	31.83 (30.02-33.63)	35.78 (33.56-38.00)	30.99 (29.03-32.95)	34.91 (32.72-37.10)
High	23.42 (21.42-25.41)	15.61 (13.70-17.51)	22.88 (22.76-25.00)	15.62 (13.80-17.44)
Miss	6.91 (5.92-7.91)	7.00 (5.64-8.34)	6.60 (5.45-7.75)	9.21 (7.51-10.92)
EDUCATION				
<HS degree	24.76 (23.10-26.42)	35.74 (33.46-38.02)	24.54 (22.77-26.31)	35.78 (33.50-38.07)
HS degree	14.45 (13.16-15.73)	14.44 (12.96-15.93)	13.96 (12.54-15.38)	15.08 (13.48-16.69)
Some post- HS	7.82 (6.82-8.83)	5.29 (4.30-6.28)	7.57 (6.47-8.66)	5.28 (4.26-6.30)
Trade/CEGEP/ Uni certificate	30.35 (28.87-31.84)	34.66 (32.66-36.65)	29.65 (28.01-31.28)	32.32 (30.24-34.39)
University degree	22.02 (20.26-23.77)	9.48 (8.00-10.95)	23.65 (21.70-25.61)	11.14 (6.64-12.65)
Missing	0.60 (0.29-0.91)	0.39 (0.12-0.66)	0.64 (0.29-0.99)	0.39 (0.16-0.63)
LANGUAGE PROFICIENCY				
French, not English	31.16 (29.47-32.86)	76.02 (73.90-78.13)	28.84 (27.08-30.60)	67.36 (65.17-69.56)
English, not French	7.79 (6.57-9.01)	0.91 (0.14-1.64)	9.21 (7.75-10.67)	1.49 (0.91-2.08)
French and English	57.67 (55.81-59.54)	22.46 (20.37-24.56)	58.37 (56.36-60.38)	30.31 (28.18-32.44)
Not French, not English	2.25 (1.68-2.81)	----	2.62 (1.96-3.29)	0.20 (0.06-0.34)
Missing	1.13 (0.71-1.54)	0.52 (0019-0.85)	0.96 (0.53-1.40)	0.63 (0.27-0.99)
IMMIGRATION & LENGTH OF STAY				
Born in Canada	72.147 (69.93-74.34)	98.13 (97.50-98.76)	68.19 (65.62-70.77)	96.59 (95.69-97.50)
0-5 years in Canada	4.50	0.25	5.27	0.41

	(3.56-5.45)	(-0.001-0.49)	(4.16-6.37)	(0.05-0.69)
6-10 years in Canada	3.55 (2.79-4.32)	----	4.10 (3.20-5.00)	0.37 (0.05-0.69)
>10 years in Canada	18.53 (16.91-20.16)	0.96 (0.57-1.36)	21.30 (19.39-23.22)	2.00 (1.26-2.74)
Missing	1.27 (0.85-1.70)	0.52 (0.19-0.86)	1.14 (0.68-1.59)	0.63 (0.27-0.99)
SENSE BELONGING TO COMMUNITY				
Very strong	14.15 (12.81-15.50)	14.40 (12.35-16.45)	15.25 (13.76-16.73)	12.94 (10.71-15.18)
Somewhat strong	32.14 (30.36-33.93)	28.43 (26.24-30.62)	32.79 (30.84-34.74)	30.80 (28.30-33.07)
Somewhat weak	30.24 (28.44-32.04)	26.33 (24.17-28.49)	29.55 (27.55-31.55)	30.69 (28.30-33.07)
Very weak	16.83 (15.34-18.31)	20.76 (18.63-22.88)	15.48 (13.93-17.03)	18.92 (16.91-20.92)
Missing	0.57 (0.26-0.87)	0.25 (0.06-0.43)	0.62 (0.27-0.96)	0.18 (0.004-0.35)
N/A	6.07 (5.01-7.14)	9.84 (7.91-11.76)	6.32 (5.09-7.55)	6.48 (5.05-7.91)
SELF-PERCEIVED HEALTH				
Excellent	26.73 (25.06-28.41)	25.81 (23.98-27.65)	25.87 (24.00-27.74)	26.43 (24.67-28.18)
Very good	33.15 (31.44-34.86)	32.12 (30.33-33.91)	32.66 (30.77-34.55)	31.56 (29.68-33.44)
Good	28.15 (26.45-29.85)	30.22 (28.47-31.98)	28.89 (26.96-30.82)	29.60 (27.75-31.45)
Fair	9.39 (8.39-10.40)	9.99 (8.83-11.16)	9.85 (8.71-10.99)	10.60 (9.25-11.95)
Poor	2.51 (1.91-3.11)	1.85 (1.37-2.33)	2.66 (1.97-3.36)	1.81 (1.33-2.30)
Missing	0.06 (-0.060-0.18)	----	0.07 (-0.070-0.21)	----
NUMBER CHRONIC CONDITIONS				
None	54.10 (52.16-56.03)	58.00 (56.12-59.88)	54.15 (51.97-56.34)	57.16 (55.12-59.19)
One	26.12 (24.42-27.81)	24.52 (22.62-26.41)	25.17 (23.27-27.07)	25.01 (23.18-26.83)
Two	12.06 (10.94-13.17)	11.32 (10.02-12.62)	12.81 (11.52-14.11)	11.43 (10.14-12.72)
Three or more	7.73 (6.72-8.69)	6.16 (5.24-7.09)	7.86 (6.80-8.92)	6.41 (5.46-7.36)
N	4859	3754	4554	3649

Note:
---- indicates a value that could not be estimated due to insufficient cell size.
The health regions corresponding to the GMF participation quintiles are given below.
2004
Q1: Montréal-Centre, Gaspésie-Iles-de-la-Madeleine, Laurentides
Q5: Mauricie-Centre-du-Québec, Côte Nord, Chaudière-Appalaches

2011
Q1: Montréal-Centre, Côte Nord, Gaspésie-Iles-de-la-Madeleine
Q5: Mauricie-Centre-du-Québec, Estrie, Abitibi-Témiscamingue

Table C–2 Pre-implementation CCHS outcome characteristics for regions in the highest and lowest GMF participation quintiles as measured in 2004 and 2011.

CCHS 1.1 (2001)	Pre-implementation outcome characteristics of regions with lowest and highest quintiles of GMF participation			
	2004		2011	
	Q1	Q5	Q1	Q5
REGULAR DOCTOR				
No	33.05 (31.32-34.78)	25.27 (23.36-27.18)	35.38 (33.43-37.33)	27.49 (25.50-29.49)
Yes	66.96 (65.12-68.60)	74.65 (72.74-76.57)	64.54 (62.59-66.50)	72.51 (70.51-74.50)
Missing	----	----	----	----
UNMET NEEDS				
No	85.92 (84.58-87.27)	87.94 (86.56-89.33)	86.12 (84.62-87.63)	85.67 (84.10-87.24)
Yes	13.99 (12.66-15.32)	11.97 (10.58-13.36)	13.77 (12.29-15.26)	14.25 (12.68-15.83)
Missing	----	----	----	----
FLUSHOT (2003)				
No	77.12 (75.63-78.62)	76.77 (74.97-78.57)	76.64 (74.90-78.39)	75.34 (73.32-77.37)
Yes	19.52 (18.3-21.01)	20.36 (18.74-21.97)	19.71 (17.96-21.46)	21.76 (19.96-23.56)
Missing	0.65 (0.26-1.05)	0.56 (0.21-0.90)	0.64 (0.19-1.10)	0.64 (0.27-1.01)
Not applicable	2.71 (1.98-3.44)	2.32 (1.54-3.10)	3.01 (2.15-3.86)	2.25 (1.42-3.09)
PAP TEST*				
No	32.11 (29.72-34.50)	37.11 (34.16-40.06)	33.82 (31.11-36.52)	36.05 (33.10-39.01)
Yes	61.54 (59.22-63.84)	55.63 (52.70-58.56)	59.45 (56.80-62.09)	59.87 (56.87-62.87)
Missing	1.29 (0.63-1.95)	0.53 (0.16-0.91)	1.46 (0.68-2.23)	0.49 (0.11-0.86)
Not applicable	5.06 (3.80-6.32)	6.73 (4.70-8.75)	5.28 (3.84-6.71)	3.59 (2.29-4.88)
MAMMOGRAM**				
No	37.67 (33.77-41.60)	34.50 (30.04-38.97)	38.02 (33.71-42.32)	33.60 (29.30-37.90)
Yes	56.35 (52.23-60.47)	61.01 (56.76-65.26)	56.15 (51.57-60.74	62.86 (58.68-67.03)
Missing	----	----	----	----
Not applicable	5.56 (3.20-7.92)	4.25 (1.78-6.73)	5.42 (2.80-8.04)	3.21 (1.23-5.19)
N	4859	3754	4554	3649

Note:
The health regions corresponding to the GMF participation quintiles are given below.

2004
Q1: Montréal-Centre, Gaspésie-Iles-de-la-Madeleine, Laurentides
Q5: Mauricie-Centre-du-Québec, Côte Nord, Chaudière-Appalaches
2011
Q1: Montréal-Centre, Côte Nord, Gaspésie-Iles-de-la-Madeleine
Q5: Mauricie-Centre-du-Québec, Estrie, Abitibi-Témiscamingue
---- value not estimated due to insufficient cell size
*restricted to females 18 years and over
**restricted to females 50 years and over

Table C–3 Pre-implementation HSAS outcome characteristics for regions in the highest and lowest GMF participation quintiles as measured in 2004 and 2011.

HSAS 2003	Pre-implementation outcome characteristics of regions with lowest and highest quintiles of GMF participation			
	2004		2011	
	Q1	Q5	Q1	Q5
HEALTH INFO				
No	32.58 (28.90-36.26)	36.18 (31.19-41.18)	31.79 (27.80-35.78)	34.33 (28.68-39.99)
Yes	7.99 (5.97-10.01)	6.92 (4.38-9.45)	6.97 (5.05-8.90)	6.27 (3.44-9.11)
Missing	4.79 (3.31-6.27)	4.38 (2.30-6.45)	4.59 (3.01-6.16)	6.50 (3.90-9.10)
Not applicable	54.64 (50.81-58.47)	52.52 (47.54-57.51)	56.65 (52.62-60.69)	52.89 (47.32-58.47)
INFO – REGULAR HR				
No	21.14 (11.20-31.09)	28.07 (12.40-43.75)	26.17 (13.75-38.59)	10.29 (-0.56-21.14)
Yes	75.92 (65.45-86.40)	70.49 (54.72-86.26)	71.42 (58.78-84.07)	89.33 (78.47-100)
Missing	----	----	----	----
Not applicable	----	----	----	----
INFO – EVE/WKEND				
No	28.46 (16.31-40.61)	32.60 (16.94-48.27)	29.12 (15.44-42.80)	33.32 (15.58-51.06)
Yes	52.79 (38.95-66.62)	38.15 (18.05-58.24)	51.53 (36.30-66.77)	37.91 (17.08-58.74)
Missing	----	----	----	----
Not applicable	17.83 (9.07-26.58)	29.25 (13.97-44.51)	18.58 (7.89-29.26)	28.77 (11.22-46.32)
INFO - NIGHT				
No	36.90 (23.64-50.15)	32.12 (14.87-49.37)	37.56 (22.96-52.15)	35.65 (15.16-56.15)
Yes	14.93 (4.66-25.21)	----	14.38 (2.94-25.83)	11.59 (-1.20-24.37)
Missing	----	----	----	----
Not applicable	47.80 (34.62-60.98)	59.47 (41.36-77.58)	48.06 (32.59-63.52)	52.76 (31.45-74.07
ROUTINE CARE				
No	52.76 (49.07-56.46)	48.66 (43.83-53.49)	51.04 (47.04-55.05)	46.26 (40.47-52.04)

Yes	12.48 (9.70-15.27)	13.71 (10.30-17.12)	12.26 (9.04-15.49)	13.36 (9.96-16.77)
Missing	5.00 (3.39-6.62)	4.68 (2.54-6.81)	4.84 (3.07-6.61)	6.78 (4.17-9.40)
Not applicable	29.75 (26.30-33.19)	32.96 (28.09-37.83)	31.85 (28.11-35.58)	33.60 (27.75-39.44)
ROUTINE - REG HR				
No	22.28 (11.35-33.21)	15.97 (5.65-26.29)	23.23 (10.70-35.76)	21.57 (9.13-34.01)
Yes	75.84 (64.86-86.82)	80.54 (70.01-91.07)	76.01 (63.48-88.54)	78.43 (65.99-90.87)
Missing	----	----	----	----
Not applicable	----	----	----	----
ROUTINE – EVE/WKEND				
No	39.86 (28.01-51.71)	32.58 (20.31-44.86)	38.51 (25.34-51.69)	42.53 (28.75-56.30)
Yes	37.12 (24.43-49.81)	27.71 (16.69-38.74)	35.00 (21.14-48.86)	29.96 (17.88-42.03)
Missing	----	----	----	----
Not applicable	22.86 (12.40-33.32)	35.68 (23.67-47.68)	26.29 (14.33-38.24)	24.77 (14.15-35.40)
IMMEDIATE CARE				
No	25.16 (21.77-28.55)	22.62 (18.59-26.66)	24.83 (21.27-28.40)	21.88 (16.74-27.02)
Yes	8.79 (6.24-11.33)	8.04 (4024-11.33)	8.28 (5.41-11.16)	5.51 (3.18-7.85)
Missing	4.93 (3.40-6.46)	4.72 (2.557-6.87)	4.81 (3.16-6.47)	6.37 (3.78-8.95)
Not applicable	61.11 (57.19-65.05)	64.61 (60.13-69.10)	62.07 (57.68-66.46)	66.24 (61.09-71.38)
IMMED – REG HR				
No	27.10 (11.84-42.35)	44.92 (25.60-64.25)	33.05 (14.69-51.42)	35.80 (15.74-55.87)
Yes	68.54 (53.29-83.79)	50.53 (32.00-69.07)	62.99 (44.62-81.36)	64.20 (44.13-84.26)
Missing	----	----	----	----
Not applicable	4.36 (0.51-8.21)	----	3.96 (-0.39-8.31)	----
IMMED – EVE/WKEND				
No	22.00 (10.73-33.26)	45.14 (25.17-65.12)	21.31 (7.74-34.88)	31.86 (10.75-52.97)
Yes	51.60 (37.21-65.98)	38.83 (22.33-55.33)	46.96 (30.14-63.78)	58.86 (37.30-80.42)
Missing	----	----	----	----
Not applicable	26.41 (13.07-39.74)	14.87 (5.02-24.71)	31.73 (15.02-48.45)	9.28 (1.18-17.39)
IMMED - NIGHT				
No	40.42 (25.72-55.13)	37.02 (21.47-52.56)	43.03 (24.87-61.19)	63.00 (42.88-83.12)

Yes	17.75 (7.48-28.02)	22.83 (9.69-35.96)	16.73 (5.28-28.18)	24.54 (6.44-42.63)
Missing	----	----	----	----
Not applicable	41.83 (26.85-56.80)	38.99 (20.09-57.90)	40.24 (22.76-57.71)	12.46 (3.13-21.79)
N	1257	1079	1042	663

Note:
---- value not estimated due to insufficient cell size
The health regions corresponding to the GMF participation quintiles are given below.
2004
Q1: Montréal-Centre, Gaspésie-Iles-de-la-Madeleine, Laurentides
Q5: Mauricie-Centre-du-Québec, Côte Nord, Chaudière-Appalaches
2011
Q1: Montréal-Centre, Côte Nord, Gaspésie-Iles-de-la-Madeleine
Q5: Mauricie-Centre-du-Québec, Estrie, Abitibi-Témiscamingue

Comparison of pre and post-implementation characteristics

Table C–4 Pre and post-implementation characteristics for regions in the highest and lowest GMF participation quintiles as measured in 2004.

	Pre and post-implementation characteristics of regions in lowest and highest quintiles of GMF participation measured in 2004			
	2004 Q1		2004 Q5	
	Pre (2001)	Post (2010)	Pre (2001)	Post (2010)
AGE	45.65 (45.41-45.88)	46.46 (46.03-46.0)	45.66 (45.40-45.91)	48.96 (48.39-49.52)
SEX				
Female	51.63 (51.38-51.87)	50.80 (50.30-51.30)	50.22 (49.89-50.55)	49.75 (49.21-50.30)
Male	48.37 (48.13-48.62)	49.20 (48.80-49.70)	49.78 (48.45-50.11)	50.25 (49.70-50.79)
ETHNICITY				
Visible Minority	15.54 (13.68-17.41)	23.01 (20.11-25.90)	0.97 (0.47-1.46)	2.32 (1.44-3.19)
White	83.33 (81.41-85.25)	73.79 (70.81-76.77)	98.51 (97.89-99.14)	94.74 (93.41-96.06)
Missing	1.13 (0.72-1.54)	3.20 (2.18-4.22)	0.52 (0.19-0.85)	2.95 (1.93-3.96)
GEOGRAPHY				
Rural	7.54 (6.30-8.77)	10.05 (8.54-11.55)	34.27 (29.86-38.69)	35.57 (29.31-41.84)
Urban	92.46 (91.23-93.70)	89.95 (88.45-91.46)	65.73 (61.31-70.13)	64.42 (58.16-70.69)
GEO AVAIL CAT				
Large center	80.50 (79.32-81.68)	78.96 (77.62-80.30)	15.37 (13.06-17.68)	18.23 (14.61-21.86)
Subspec center	3.77 (2.45-5.09)	4.43 (2.82-6.04)	18.85 (16.04-21.66)	18.62 (13.31-23.94)
Periph spec center	8.22 (6.65-9.79)	9.60 (8.27-10.92)	31.77 (27.20-36.34)	37.91 (30.97-44.85)
Reg spec center	1.16	1.09	4.72	6.17

	(0.84-1.48)	(0.84-1.34)	(3.79-5.65)	(5.18-7.17)
Periph rural zone	1.99 (1.21-2.77)	2.29 (1.71-2.86)	23.14 (18.33-27.95)	15.14 (10.16-20.12)
Intermed rural zone	0.88 (0.55-1.21)	0.99 (0.68-1.31)	2.60 (1.91-3.29)	2.39 (1.37-3.41)
Remote rural zone	3.48 (2.77-4.19)	2.64 (2.24-3.05)	1.32 (0.99-1.65)	0.97 (0.21-1.74)
Isolated rural zone	----	----	2.22 (1.47-2.98)	0.55 (0.40-0.76)
MARITAL STATUS				
Married	42.95 (41.02-44.88)	38.89 (35.58-42.20)	41.81 (39.86-43.76)	39.26 (35.53-42.99)
Common-Law	14.39 (13.08-15.71)	16.66 (14.55-18.78)	20.12 (18.44-21.80)	25.86 (22.90-28.82)
Widowed	7.47 (6.76-8.17)	5.47 (4.39-6.56)	5.71 (4.97-6.46)	5.88 (4.39-6.56)
Separated	2.78 (2.30-3.26)	2.61 (1.72-3.50)	2.23 (1.71-2.75)	1.98 (1.10-2.86)
Divorced	6.37 (5.56-7.18)	6.80 (5.43-8.18)	5.94 (4.97-6.92)	6.07 (4.00-8.14)
Single	26.04 (24.58-27.49)	29.56 (27.27-31.84)	24.18 (22.20-26.12)	20.79 (18.19-23.40)
INCOME ADEQUACY				
Low	5.15 (4.38-5.93)	1.94 (0.95-2.94)	4.98 (4.09-5.86)	2.36 (0.90-3.82)
Low-Middle	10.27 (9.08-11.45)	4.29 (3.16-5.41)	8.45 (7.24-9.65)	3.64 (2.11-5.17)
Middle	22.42 (20.98-23.87)	16.14 (13.55-18.73)	28.20 (26.15-30.25)	16.31 (13.69-18.93)
Middle-High	31.83 (30.02-33.63)	25.32 (22.52-28.11)	35.78 (33.56-38.00)	27.43 (23.79-31.06)
High	23.42 (21.42-25.41)	36.49 (33.08-39.91)	15.61 (13.70-17.51)	36.61 (32.36-40.86)
Miss	6.91 (5.92-7.91)	15.82 (13.61-18.03)	7.00 (5.64-8.34)	13.66 (11.16-16.16)
EDUCATION				
<HS degree	24.76 (23.10-26.42)	14.85 (12.51-17.19)	35.74 (33.46-38.02)	21.20 (18.12-24.27)
HS degree	14.45 (13.16-15.73)	11.30 (9.26-13.34)	14.44 (12.96-15.93)	11.02 (8.71-13.33)
Some post-HS	7.82 (6.82-8.83)	6.58 (5.15-8.01)	5.29 (4.30-6.28)	6.73 (4.72-8.73)
Trade/CEGEP/ Uni certificate	30.35 (28.87-31.84)	36.22 (33.50-38.93)	34.66 (32.66-36.65)	44.89 (40.84-48.94)
University deg	22.02 (20.26-23.77)	27.66 (24.85-30.46)	9.48 (8.00-10.95)	12.71 (9.62-15.80)
Missing	0.60 (0.29-0.91)	3.39 (2.36-4.43)	0.39 (0.12-0.66)	3.45 (2.33-4.57)
LANGUAGE PROFICIENCY				
French, not English	31.16	30.23	76.02	67.14

	(29.47-32.86)	(27.62-32.84)	(73.90-78.13)	(63.45-70.83)
English, not French	7.79 (6.57-9.01)	8.14 (5.95-10.32)	0.91 (0.14-1.64)	0.35 (0.14-0.55)
French and English	57.67 (55.81-59.54)	57.04 (54.17-59.92)	22.46 (20.37-24.56)	29.58 (26.01-33.15)
Not French, nor English	2.25 (1.68-2.81)	2.04 (0.44-3.64)	----	----
Missing	1.13 (0.71-1.54)	2.55 (1.63-3.46)	0.52 (0019-0.85)	2.93 (1.88-3.99)
IMMIGRATION & LENGTH OF STAY				
Born in Canada	72.147 (69.93-74.34)	67.64 (64.63-70.64)	98.13 (97.50-98.76)	95.46 (94.14-96.78)
0-5 years in Canada	4.50 (3.56-5.45)	7.44 (5.53-9.35)	0.25 (-0.001-0.49)	0.52 (0.03-1.00)
6-10 years in Canada	3.55 (2.79-4.32)	3.96 (2.77-5.15)	----	----
>10 years in Canada	18.53 (16.91-20.16)	17.94 (15.22-20.66)	0.96 (0.57-1.36)	1.17 (0.47-1.87)
Missing	1.27 (0.85-1.70)	3.02 (2.00-4.04)	0.52 (0.19-0.86)	2.72 (1.74-3.70)
SENSE BELONGING TO COMMUNITY				
Very strong	14.15 (12.81-15.50)	12.23 (10.19-14.27)	14.40 (12.35-16.45)	15.58 (12.46-18.70)
Somewhat strong	32.14 (30.36-33.93)	43.99 (40.73-47.24)	28.43 (26.24-30.62)	41.44 (37.34-45.53)
Somewhat weak	30.24 (28.44-32.04)	30.88 (28.09-33.66)	26.33 (24.17-28.49)	30.36 (26.27-34.44)
Very weak	16.83 (15.34-18.31)	9.89 (8.25-11.53)	20.76 (18.63-22.88)	9.81 (6.91-12.72)
Missing	0.57 (0.26-0.87)	0.92 (0.53-1.31)	0.25 (0.06-0.43)	0.83 (0.28-1.40)
N/A	6.07 (5.01-7.14)	2.09 (1.24-2.95)	9.84 (7.91-11.76)	1.97 (0.90-3.04)
SELF-PERCEIVED HEALTH				
Excellent	26.73 (25.06-28.41)	22.63 (19.85-25.41)	25.81 (23.98-27.65)	21.60 (18.02-25.17)
Very good	33.15 (31.44-34.86)	34.36 (31.57-37.15)	32.12 (30.33-33.91)	33.60 (30.18-37.02)
Good	28.15 (26.45-29.85)	30.87 (27.71-33.92)	30.22 (28.47-31.98)	33.03 (29.44-36.62)
Fair	9.39 (8.39-10.40)	9.27 (7.37-11.18)	9.99 (8.83-11.16)	8.99 (6.91-11.06)
Poor	2.51 (1.91-3.11)	2.84 (1.80-3.87)	1.85 (1.37-2.33)	2.77 (1.45-4.09)
Missing	----	----	----	----
NUMBER CHRONIC CONDITIONS				
None	54.10	48.37	58.00	48.16

	(52.16-56.03)	(45.37-51.36)	(56.12-59.88)	(44.75-51.56)
One	26.12 (24.42-27.81)	27.58 (24.48-30.68)	24.52 (22.62-26.41)	26.49 (23.31-29.67)
Two	12.06 (10.94-13.17)	13.05 (10.92-15.19)	11.32 (10.02-12.62)	11.75 (9.42-14.08)
Three or more	7.73 (6.72-8.69)	11.00 (9.17-12.82)	6.16 (5.24-7.09)	13.60 (10.42-16.78)
N	4859	2542	3754	1846
Note: ---- value not estimated due to insufficient cell size The health regions corresponding to the GMF participation quintiles are given below. 2004 Q1: Montréal-Centre, Gaspésie-Iles-de-la-Madeleine, Laurentides Q5: Mauricie-Centre-du-Québec, Côte Nord, Chaudière-Appalaches				

Barriers to accessing different forms of care

Table C–5 Pre and post-implementation prevalence of reported barriers for not having a regular medical doctor, reporting unmet health care needs, and not receiving a flu shot, Pap test or mammogram for regions in the highest and lowest GMF participation quintiles as measured in 2004.

	Pre and post-implementation prevalence of reported barriers in regions with lowest and highest quintiles of 2004 GMF participation			
	CCHS 2003		CCHS 2010	
	Q1	Q5	Q1	Q5
REGULAR DOCTOR				
Geo availability				
No	69.45 (65.88-73.03)	56.65 (50.25-63.05)	50.17 (44.56-55.76)	37.83 (29.83-45.84)
Yes	29.81 (26.22-33.39)	42.44 (36.11-48.78)	49.05 (43.47-54.62)	62.09 (54.09-70.09)
Personal				
No	36.13 (32.44-39.81)	48.00 (42.29-53.72)	50.91 (45.43-56.39)	59.78 (50.56-69.00)
Yes	63.14 (59.47-66.81)	51.09 (45.27-56.91)	48.31 (42.79-53.83)	40.14 (30.92-49.37)
Other				
No	89.94 (87.90-91.97)	91.00 (87.63-94.38)	93.88 (91.61-96.16)	91.68 (85.98-97.37)
Yes	9.33 (7.32-11.33)	8.09 (4.87-11.31)	5.33 (3.22-7.44)	8.24 (2.54-13.95)
N	**1549**	**674**	**628**	**304**
UNMET NEEDS				
Geo availability				
No	93.33 (91.32-95.35)	83.61 (78.12-89.09)	92.12 (88.67-95.56)	91.93 (86.99-96.86)
Yes	5.87 (4.00-7.74)	15.39 (9.88-20.90)	7.31 (3.92-10.70)	7.92 (3.02-12.82)
Time				
No	36.59 (31.32-41.86)	39.94 (32.97-46.91)	33.07 (25.55-40.59)	38.87 (27.65-50.10)
Yes	62.62	59.06	66.36	60.97

	(57.35-68.88)	(52.11-66.01)	(58.80-73.92)	(49.74-72.20)
Financial				
No	93.51 (91.47-95.55)	93.17 (89.69-96.66)	96.50 (93.76-99.23)	99.67 (99.17-100)
Yes	5.70 (3.78-7.62)	5.82 (2.47-9.17)	2.93 (0.27-5.58)	-----
Personal				
No	67.78 (62.84-72.72)	67.97 (60.84-75.10)	84.24 (78.53-89.94)	80.59 (71.42-89.76)
Yes	31.43 (26.45-36.40)	31.03 (23.98-38.08)	15.19 (9.47-20.92)	19.26 (10.10-28.42)
Other				
No	88.96 (86.06-91.86)	90.89 (86.63-95.17)	78.63 (71.91-85.36)	78.07 (67.62-88.52)
Yes	10.24 (7.44-13.04)	8.10 (4.03-12.17)	20.79 (14.09-27.49)	21.78 (11.33-32.23)
N	**814**	**427**	**367**	**218**
FLUSHOT				
Geo availability				
No	98.18 (96.67-99.68)	99.24 (98.70-99.78)	98.81 (98.23-99.39)	98.27 (97.26-99.27)
Yes	----	----	0.44 (0.061-0.82)	0.97 (0.036-1.90)
Time				
No	97.60 (96.01-99.18)	98.52 (97.68-99.35)	97.61 (96.84-98.48)	97.19 (95.61-98.78)
Yes	0.71 (0.19-1.22)	0.72 (0.12-1.32)	1.64 (0.94-2.34)	2.04 (0.51-3.57)
Financial				
No	97.90 (96.25-99.54)	98.84 (98.06-99.63)	98.94 (98.40-99.49)	99.13 (98.64-99.62)
Yes	0.41 (-0.023-1.05)	----	0.31 (0.0018-0.62)	----
Personal				
No	5.31 (3.73-6.88)	4.25 (2.53-5.97)	6.36 (4.90-7.82)	7.05 (4.53-9.66)
Yes	93.00 (90.86-95.14)	94.99 (93.22-96.76)	92.89 (91.36-94.42)	92.14 (89.59-94.70)
Other				
No	5.72 (3.99-7.45)	4.25 (2.56-5.94)	4.90 (3.64-6.17)	4.62 (2.89-6.33)
Yes	92.59 (90.38-94.79)	94.99 (93.26-96.72)	94.35 (93.03-95.66)	94.62 (92.89-96.36)
N	**1813**	**1052**	**2013**	**1421**
PAP TEST*				
Geo availability				
No	92.92 (90.88-94.95)	93.93 (91.38-96.48)	91.93 (88.71-95.15)	95.20 (82.79-97.60)
Yes	0.90 (0.29-1.51)	1.07 (0.29-1.85)	0.66 (0.042-1.28)	----
Miss	6.18	5.00	7.41	4.72

	(4.24-8.13)	(2.59-7.41)	(4.24-10.58)	(2.31-7.13)
Time				
No	90.30 (87.61-93.00)	91.41 (88.06-94.76)	89.06 (85.13-92.99)	93.76 (91.09-96.42)
Yes	3.52 (1.28-5.76)	3.59 (1.41-5.76)	3.53 (1.40-5.67)	1.52 (0.31-2.73)
Miss	6.18 (4.24-8.13)	5.00 (2.59-7.41)	7.41 (4.24-10.58)	4.72 (2.31-7.13)
Financial				
No	93.71 (91.75-95.67)	94.81 (92.36-97.26)	92.59 (89.42-95.76)	95.28 (92.87-97.69)
Yes	----	----	----	----
Miss	6.18 (4.24-8.13)	5.00 (2.59-7.41)	7.41 (4.24-10.58)	4.72 (2.31-7.13)
Personal				
No	26.42 (22.88-29.95)	31.46 (26.51-36.41)	37.73 (31.33-44.14)	37.62 (30.85-44.39)
Yes	67.40 (63.70-71.09)	63.54 (58.54-68.54)	54.86 (48.56-61.16)	57.66 (51.00-64.32)
Miss	6.18 (4.24-8.13)	5.00 (2.59-7.41)	7.41 (4.24-10.58)	4.72 (2.31-7.13)
Other				
No	67.36 (63.32-74.40)	64.16 (59.32-69.00)	56.69 (50.39-62.99)	56.49 (49.58-63.39)
Yes	26.45 (22.87-30.04)	30.94 (26.00-35.68)	35.90 (29.49-42.31)	38.79 (31.74-45.85)
Miss	6.18 (4.24-8.13)	5.00 (2.59-7.41)	7.41 (4.24-10.58)	4.72 (2.31-7.13)
N	**1245**	**786**	**609**	**455**
MAMMOGRAM**				
Geo availability				
No	97.63 (96.06-99.19)	95.64 (92.10-99.18)	95.93 (91.60-100)	99.62 (98.80-100)
Yes	0.78 (0.21-1.35)	----	----	----
Miss	1.59 (0.13-3.05)	----	----	----
Time				
No	95.02 (92.20-97.84)	92.21 (87.73-96.68)	89.41 (81.73-97.10)	96.70 (92.85-100)
Yes	3.39 (0.99-5.79)	6.03 (1.99-10.06)	8.04 (0.97-15.10)	----
Miss	1.59 (0.13-3.05)	----	----	----
Financial				
No	98.33 (96.87-99.79)	98.12 (96.87-99.79)	97.45 (93.73-100)	100
Yes	----	----	----	----
Miss	1.59 (0.13-3.05)	----	----	----
Personal				

No	21.15 (13.94-28.36)	24.26 (15.27-33.25)	23.62 (11.90-35.34)	27.91 (7.93-47.89)
Yes	77.26 (69.89-84.63)	73.97 (64.90-83.04)	73.83 (61.73-85.93)	72.09 (52.11-92.07)
Miss	1.59 (0.13-3.05)	----	----	----
Other				
No	74.28 (66.22-82.33)	79.62 (71.16-88.09)	76.59 (64.63-88.55)	74.26 (54.02-94.51)
Yes	24.13 (16.21-32.07)	18.61 (10.18-27.04)	20.86 (9.34-32.39)	25.74 (5.49-45.98)
Miss	1.59 (0.13-3.05)	----	----	----
N	**309**	**162**	**136**	**100**

Note:
---- value not estimated due to insufficient cell size
*restricted to females 18 years and over
**restricted to females 50 years and over
The health regions corresponding to the GMF participation quintiles are given below.
2004
Q1: Montréal-Centre, Gaspésie-Iles-de-la-Madeleine, Laurentides
Q5: Mauricie-Centre-du-Québec, Côte Nord, Chaudière-Appalaches

Table C–6 Cross-tabulations of unmet health care needs, flu shot, Pap test or mammogram with having a regular medical doctor for all cycles of the CCHS and averaged across all health regions of Quebec.

CCHS		Regular medical doctor	
		No	Yes
Unmet HC	No	83.21 (82.43-84.00)	87.96 (87.54-88.38)
	Yes	16.79 (16.00-17.57)	12.04 (11.62-12.46)
Flu shot (65+)	No	67.89 (64.2-71.45)	38.99 (37.92-40.06)
	Yes	32.11 (28.55-35.67)	61.01 (59.94-62.08)
Pap test (F, 18+)	No	43.44 (41.60-45.30)	33.16 (32.45-33.87)
	Yes	56.55 (54.70-58.40)	66.84 (66.13-67.55)
Mammogram (F, 50+)	No	61.59 (58.18-65.00)	34.72 (33.65-35.78)
	Yes	38.41 (35.00-41.82)	65.28 (64.22-66.35)

Part III: Regressions

Linear DD model, patient GMF participation

Table C–7 Coefficient and 95% confidence interval on patient GMF participation for the full linear DD model for all outcomes.

Full linear DD model	Patient GMF participation			
Outcome	**β**	**95% CI**		**N**
Regular medical doctor	-0.0089	-0.11	0.097	95370
Regular medical doctor (with extra interaction of GMFpar2 and year)	-0.089	-0.23	0.053	95370
Regular medical doctor (with extra interaction of rss and year)	-0.16	-0.39	0.074	95370
Regular doctor barrier – geographic availability	-0.098	-0.34	0.14	16847
Regular doctor barrier – personal barrier	0.087	-0.16	0.33	16847
Regular doctor – other barriers	0.091	-0.068	0.25	16847
Unmet health care needs	0.0061	-0.13	0.14	68787
Unmet need reason – geographic accessibility	-0.082	-0.33	0.16	9014
Unmet need reason – time barriers	-0.41	-0.84	0.025	9014
Unmet need reason – financial barriers	-0.045	-0.20	0.11	9014
Unmet need reason – personal barriers	0.79	0.45	1.13	9014
Unmet need reason – other barriers	-0.23	-0.61	0.16	9014
Difficulty accessing health information	-0.093	-0.42	0.23	7390
Difficulty accessing health information during regular hours	0.25	-0.54	1.04	1146
Difficulty accessing health information during evening or weekend	0.37	-0.78	1.53	864
Difficulty accessing health information during middle of the night	0.17	-0.88	1.22	629
Difficulty accessing routine care	-0.011	-0.31	0.29	11610
Difficulty accessing routine care during regular hours	-0.12	-0.76	0.52	2131
Difficulty accessing routine care during evening or weekend	0.23	-0.78	1.23	1458
Difficulty accessing immediate care for minor health problems	0.18	-0.28	0.64	5340
Difficulty accessing immediate care during regular hours	0.46	-0.46	1.38	1271
Difficulty accessing immediate care during evening or weekend	-0.70	-1.88	0.48	1027
Difficulty accessing immediate care during middle of the night	-1.07	-2.31	0.16	759
Received a flu shot within the past year	0.016	-0.083	0.12	77741
Received a flu shot within the past year (age 65+)	0.13	-0.14	0.41	16579
Flu shot barrier – geographic accessibility	-0.0068	-0.025	0.011	
Flu shot barrier – time barriers	0.0046	-0.032	0.041	46384
Flu shot barrier – financial barriers	-0.0075	-0.038	0.023	46384

Flu shot barrier – personal barriers	-0.084	-0.18	0.015	46384
Flu shot barrier – other barriers	-0.12	-0.21	-0.034	46384
Received a Pap test within the past three years (women 18+)	0.039	-0.22	0.30	37042
Pap test barrier – geographic accessibility	0.0045	-0.039	0.048	13586
Pap test barrier – time barriers	-0.95	-0.25	0.063	13586
Pap test barrier – financial barriers	0.0032	-0.011	0.017	13586
Pap test barrier – personal barriers	0.071	-0.34	0.48	13586
Pap test barrier – other barriers	0.10	-0.32	0.53	13586
Received a mammogram within the past two years (women 35+)	-0.35	-0.65	-0.052	27864
Received a mammogram within the past two years (women 35-49)	-0.31	-0.82	0.20	9636
Received a mammogram within the past two years (women 50+)	-0.013	-0.63	0.050	18228
Mammogram barrier – personal barriers	0.12	-0.59	0.83	3128
Mammogram barrier – other barriers	-0.18	-0.90	0.53	3128
Had an injury within the past year	-2.07	-3.98	-0.16	95311

Logistic DD model, physician GMF participation

Table C–8 Coefficient and 95% confidence interval on physician GMF participation for the full logistic DD model for all outcomes.

Full logistic DD model	**Physician GMF participation**			
Outcome	**Mrg Effect**	**95% CI**		**N**
Regular medical doctor	-0.057	-0.14	0.025	95370
Regular doctor barrier – geographic availability	-0.0076	-0.22	0.20	16847
Regular doctor barrier – personal barrier	0.085	-0.12	0.29	16847
Regular doctor – other barriers	-0.087	-0.25	0.071	16847
Unmet health care needs	0.032	-0.060	0.12	68787
Unmet need reason – geographic accessibility	-0.10	-0.30	0.091	9014
Unmet need reason – time barriers	-0.22	-0.57	0.13	9014
Unmet need reason – financial barriers	-0.099	-0.26	0.058	9014
Unmet need reason – personal barriers	0.48	0.18	0.78	9014
Unmet need reason – other barriers	-0.029	-0.29	0.24	9014
Difficulty accessing health information	0.053	-0.19	0.30	7390
Difficulty accessing health information during regular hours	0.46	-0.12	1.04	1146
Difficulty accessing health information during evening or weekend	0.89	0.033	1.75	864
Difficulty accessing health information during middle of the night	0.50	-0.41	1.41	629
Difficulty accessing routine care	0.14	-0.056	0.35	11610
Difficulty accessing routine care during regular hours	-0.31	-0.76	0.14	2131
Difficulty accessing routine care during evening or weekend	-0.15	-0.90	0.60	1458

Difficulty accessing immediate care for minor health problems	-0.034	-0.36	0.29	5340
Difficulty accessing immediate care during regular hours	0.34	-0.31	0.99	1271
Difficulty accessing immediate care during evening or weekend	-0.015	-0.84	0.81	1027
Difficulty accessing immediate care during middle of the night	-0.62	-1.45	0.21	759
Received a flu shot within the past year	0.0078	-0.073	-0.089	77741
Received a flu shot within the past year (age 65+)	0.020	-0.19	0.23	16579
Flu shot barrier – geographic accessibility	-0.011	-0.023	0.00085	46384
Flu shot barrier – time barriers	0.021	-0.0085	0.051	46384
Flu shot barrier – financial barriers	0.021	-0.013	0.054	46384
Flu shot barrier – personal barriers	-0.058	-0.14	0.028	46384
Flu shot barrier – other barriers	0.031	-0.049	0.11	46384
Received a Pap test within the past three years (women 18+)	-0.055	-0.23	0.12	37042
Pap test barrier – geographic accessibility	0.0072	-0.046	0.061	13586
Pap test barrier – time barriers	-0.082	-0.19	0.030	13586
Pap test barrier – financial barriers				13586
Pap test barrier – personal barriers	0.12	-0.17	0.40	13586
Pap test barrier – other barriers	0.020	-0.27	0.31	13586
Received a mammogram within the past two years (women 35+)	-0.24	-0.45	-0.034	27864
Received a mammogram within the past two years (women 50+)	-0.20	-0.44	0.044	18228
Mammogram barrier – personal barriers	0.0061	-0.46	0.47	3128
Mammogram barrier – other barriers	-0.015	-0.51	0.48	3128