THE ASSOCIATION OF CONTINUITY OF FAMILY PHYSICIAN CARE WITH HEALTH CARE SERVICES UTILIZATION AND COSTS IN NEWFOUNDLAND AND LABRADOR

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By

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DEDICATION

This thesis is dedicated to my wife, Tanya, for her encouragement, patience and support while I completed this project and to my parents, Neil and Rita, for their encouragement and everlasting faith in me.

ABSTRACT

The objective of this study was to investigate the relationship of continuity of family physician (FP) care with health care services utilization and costs as well as the effect of age on these relationships in a general primary care sample in a Canadian province using health survey and administrative data.

Samples from the provincial component of the Canadian Community Health Survey (CCHS) (2000/01) and the Medical Care Plan (MCP) provincial health insurance registry file (2003) were linked to four years of fee-for-service physician claims and inpatient hospital abstracts (1999-2002). Continuity of FP care was estimated by the Continuity of Care index (COC) using physician claims. Survey respondents/patients were classified into either low, medium, or high continuity depending on index value. Multi-variate regression (log-linear, ordinary least squares (OLS) or tobit, depending on outcome) was used to examine the association of continuity of care with health care services utilization and cost outcomes while controlling for predisposing, enabling and need factors as described in Andersen's behavioral model of health services use.

The association of continuity of care with health care services utilization outcomes was investigated using both the CCHS (Phase I) and MCP (Phase II) samples while the association of continuity of care with health care cost outcomes was investigated using the MCP sample only. Using the MCP sample, two analyses involving health care services utilization and cost outcomes were conducted, a cross-sectional analysis where continuity of care and outcomes were measured over the same four-year period, and a longitudinal analysis where continuity was measured over a two-year period (1999-2000) and outcomes were measured over the following two years (2001-2002).

Regression analysis showed that higher continuity of FP care was associated with small to moderate reductions in hospitalization for ambulatory-sensitive conditions (ACSCs) and hospital costs in both cross-sectional and longitudinal analyses. Analysis by age group provided evidence that reductions increased with age and "does-response" relationships where reductions in these outcomes became larger with increasing continuity level, were often seen at older age groups. For example, in the 75+ age group, reductions in hospitalizations for ACSCs were 25.8% for medium continuity and 35.0% for low continuity, relative to high continuity (longitudinal analysis); while reductions in hospital cost were 11.7% for medium continuity and 19.3% for low continuity (cross-sectional analysis). Higher continuity of care was also associated with reductions in total hospitalization, specialist utilization/costs, and total physician costs in cross-sectional analyses.

The study provides strong evidence that continuity of FP care results in reduced hospitalization for ambulatory-sensitive chronic illness and hospital costs in a universally-insured health care system, probably through improvements in prevention and/or management of chronic illness, which may take on "increased importance" in older individuals. Although evidence of associations of continuity of FP care with the other health care utilization and cost outcomes was found, the lack of directional associations seen in the longitudinal analysis preclude us from concluding that it is continuity of care which is driving the observed changes in these other outcomes. Thus, alternate explanations for the association of continuity of care with these other outcomes cannot be ruled out.

A modified model of health services use incorporating a visit-based measure of continuity of FP care and accounting for FP utilization, based on Andersen's model, illustrating the main study findings is provided.

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LIST OF ACRONYMS

ACSCs - ambulatory-care-sensitive conditions

ANOVA - analysis of variance

CCHS - Canadian Community Health Survey

CDMS - Clinical Database Management System

CHC - community health centre

CIHI - Canadian Institute for Health Information

COC - Continuity of Care Index

CPWC - cost per weighted case

DAD - Discharge Abstract Database

ER - emergency room

FP - family physician

HbA_{1c} - glycosylated hemoglobin

HMO - health maintenance organization

HSU - health services utilization

HTF - Health Transition Fund

ICD-9/ICD-10-CA - International Classification of Diseases versions 9 and 10 Canadian Adaptation

IOM - Institute of Medicine

MCP - Medical Care Plan (Provincial Health Insurance Plan)
NL - Newfoundland and Labrador

NLCHI - Newfoundland and Labrador Centre for Health Information

OLS regression - ordinary least squares regression

PHCTF - Primary Health Care Transition Fund

RIW - resource intensity weight

SDC - surgical day-care

SECON - Sequential Provider Continuity Index

SPSS - Statistical Package for Social Sciences

UPC - Usual Provider Continuity Index

CHAPTER 1: INTRODUCTION

1.1 Background and Rationale

Health Canada (2008), defines primary health care as "an approach to health and a spectrum of services beyond the traditional health care system, which includes all services that play a part in health, such as income, housing, education, and environment". Primary care is defined as "the element within primary health care that focuses on health care services, including health promotion, illness and injury prevention, and the diagnosis and treatment of illness and injury" (Health Canada, 2008). Primary care stands at the centre of the health care system with its key functions of providing an entry point to care, delivering core preventive and medical care, and aiding patients in integration of care (Schoen et al., 2004). Primary care normally deals with common, often ill-defined problems, generally in community settings such as doctor's offices, health care centers, schools, and homes (Starfield, 1998). It provides "preventive, curative and rehabilitative services to maximize health and well-being". (Starfield, 1998) In Canada, primary care providers include family physicians, nurse practitioners, nurses, pharmacists, dentists, social workers, psychologists, as well as other providers.

Effective primary care has the potential to improve health outcomes and cost-effectiveness of the health care system and, as such, has been found to be associated with various benefits at both the individual and macro-levels. For example, people with a primary care physician rather than a specialist as their regular source of care have been shown to have better health outcomes and lower health care costs (Franks and Fiscella, 1998) while countries with better primary care systems have been found to have lower mortality rates, higher births weights as well as lower health care costs (Starfield, 1991; Starfield, 1994; Starfield and Shi, 2002; Macinko, et al., 2003).

One of the most important characteristics of primary care and one of the defining principles of family medicine is continuity of care (Kelly, 1997; McWhinney, 1997). There has been, however, a lack of consensus on how continuity is defined and measured, especially across healthcare disciplines, which has impeded the understanding of the importance of continuity as well as research in the area (Reid et al, 2002). Continuity of care is generally thought of as a multi-dimensional concept and, over the years, researchers have developed multi-dimensional models of continuity of care in attempts to dispel confusion about the concept and recognizing that there are many different aspects to continuity (Hennen, 1975; Bachrach, 1981; Freeman et al., 2000; Reid et al., 2002; Saultz, 2003). The models explain the different dimensions or types of continuity and possible mechanisms of action in affording benefits to patients. The most well-known model continuity of care in Canada is perhaps that presented by Reid et al., (2002) in a review of studies of continuity of care completed for the Canadian Health Services Research Foundation and other stakeholders. These authors maintain that continuity of care exists in three forms or types: informational continuity, management continuity and relational or provider continuity.

In primary care, continuity of care is generally viewed as "the relationship between physician and patient (i.e. relational or provider continuity) that extends beyond single episodes of illness" (Hennen, 1975; Rogers and Curtis, 1980). Having a regular primary care physician has been found to be associated with better problem recognition, improved preventive care, improved patient satisfaction and treatment adherence, reduced hospitalization and emergency room (ER) visits, and to a lesser extent reductions in specialists visits and health care costs (Hennen, 1975; Rogers and Curtis, 1980; Kelly, 1997; McWinney, 1997; Starfield, 1998; Saultz and Abedaiwi, 2004; Fenton et al., 2008; Gulliford et al., 2007; Cyr et al., 2006; Cree et al., 2006; Menec et al., 2006; Starfield et al., 2009, De Maeseneer et al., 2003; Hollander et al., 2009).

Even though the elderly, a traditionally vulnerable group, are more likely to be financially-disadvantaged, have more chronic illness and to be hospitalized and have preventive procedures and checkups (Steven et al., 1998; Ettner, 1999; Hayward and Coleman, 2003; Statistics Canada, 2005), most studies examining the relationship between continuity of physician care and patient outcomes have been done on pediatric or adult populations (Alpert et al., 1976; Butler et al., 1985; Christakis et al., 1999; Christakis et al.; Gill et al., 1997; Gill and Mainous, 1998, Mainous and Gill, 1998; Menec et al., 2006). Furthermore, although elderly people have been found to value continuity of care more than younger people (Kearley et al, 2001; Nutting, 2003) and continuity of primary care provider has been found to be associated with better health outcomes, such as reduced hospitalization and ER visits in small number of studies involving elderly samples (Wasson et al., 1984; Menec et al., 2006; Ionescu-ittu et al., 2007; Knight et al., 2009), there is generally a lack of quality studies in this area and more research is needed to investigate whether better continuity of care for seniors is associated with better health outcomes. As the proportion of elderly people in the population of Canada increases (Statistics Canada, 2008) it is important to study the association of continuity of care with health care utilization and other health outcomes in this group in order to aid in determining whether they should be provided with high levels of continuity of primary care physician. Demonstrating the importance of continuity of care is particularly important during a time of primary health care reform when family physicians (FPs) in solo/small-group practice are increasingly being replaced by large multidisciplinary teams (Knight et al., 2009). Traditional personal continuity is increasingly dismissed as irrelevant and outdated and some authors indicate that personal care provided by a single primary care physician may not be feasible for economic reasons such as limited staff and rapid staff turn-over (Saultz and Albedaiwi, 2004; Newbury, 2000). Today, young people are more mobile, for example, due to relocating to obtain education and search for employment, and physicians are less likely to make long-term commitments to a single practice (Newbury, 2000). All of these factors reduce the likelihood of the establishment of long-lasting physician-patient relationships. In addition, there is increasing belief in the effectiveness of team care, especially in the management of chronic illnesses. It is argued that a team may reap the benefits of "more eyes and ears, the insights of different knowledge and a wider range of skills" and experience of team members (Wagner, 2000). For example, the most effective chronic disease interventions involve a co-ordinated multidisciplinary care team where the primary care physician "delegates responsibilities to team members to ensure appropriate clinical and self-management support services" (Wagner, 2000). However, Reid et al. (2002) state that despite policy reports recommending shifts to primary care teams, there is relatively little evidence about the benefits and/or risks of a group of health care providers being responsible for patient care. The same authors caution that although teams may improve access and comprehensiveness of care, they may endanger other attributes of primary care such as continuity and co-ordination (Reid et al., 2003). However, more recently a review of primary health care evaluation studies conducted for the Canadian Health Services Research Foundation concluded that collaborative models of primary health care involving primary health care teams could result in better patient satisfaction and outcomes, better provider satisfaction, knowledge and skills and more effective resource utilization (Barrett et al., 2007).

Thus, evidence supporting the value of traditional interpersonal care by a single physician may be of particular value to policy makers. Proving the value of traditional interpersonal continuity would require demonstration of better patient outcomes, health care system efficiencies or other positive benefits when this attribute of care is present. "Continuity of care is of value only to the extent that it has a [beneficial] impact on the outcome of care, the prevention or reduction of physical, mental or social disability, the satisfaction of patients or the cost of care" (Gonnella and Herman, 1980).

In addition, there has been a lack of investigation of the impact of continuity of care in countries with universally-funded health care, such as Canada. Much of the study of continuity of care and outcomes has been carried out in the United States where many issues in the context of the health care system (e.g. health insurance) are irrelevant in Canada. Even though there are no user fees and people are free to seek care from the physician of their choice (Reid et al., 2002; Menec et al., 2005) barriers to continuity of care still remain in Canada such as poor socio-economic status. For example, in Menec et al. (2001) found continuity of primary care provider to be lower in less affluent neighbourhoods in In addition, most studies investigating the relationship of continuity of care with outcomes have been done over relatively short time periods of one or two years. It is especially important to study the relationship of continuity over longer time periods given the slow progression of chronic illnesses such as diabetes (Lin et al., 2010).

The present study involves the secondary use of population-based administrative health databases available through the Newfoundland and Labrador Centre for Health Information in order to examine the association of continuity of family physician (FP) care with health care services utilization and costs while controlling for common confounders, a well as examining the effect of age on these associations. The study is the first to examine the association of continuity of care with health care services utilization and costs in the province of Newfoundland and Labrador and one of only a few studies to do so in Canada where people receive universal health care coverage and have free choice of primary care physician. The present study is one of the few examining the association of continuity of primary care physician with hospital utilization and cost and, to our knowledge, is the first to examine the relationship of continuity of FP care with specialist utilization outcomes in a general primary care sample including hospitalized people. It also adds to the relatively modest literature on the economic benefits of continuity of primary care and examines the relationship of continuity of care and outcomes over a longer time period (4 years) than most other studies on the topic.

In addition, the study is one of the first to examine the effect of patient/client age on the relationship of continuity with health care service utilization and costs by conducting analyses in different age groups in the same study (including the elderly), and again the first to do so in a general primary care sample including hospitalized individuals. In the study we hypothesize a modification of the well-known Andersen's behavioural model of health services use, incorporating an index-based measure of continuity of care.

The study involves two samples, each with advantages, the results from which complement each other in investigation of the study research questions. The first is a sample from the Newfoundland and Labrador portion of the Canadian Community Health Survey (CCHS) version 1.1 (2000/01), while the second is a sample from the Medical Care Plan (MCP) beneficiary or registration file, the provincial health insurance registry. The former has more co-variates available for use in analysis while the latter has a much larger sample size, which provides more statistical power.

The study also involves two types of analyses: cross-sectional analyses over a longer time period than most previous studies (4-years) in which continuity of care and outcomes were measured over the same time period, as well as longitudinal analyses in which continuity of care was measured over an earlier time period than outcomes. This was done in order to better establish whether it was actually continuity which is driving any observed differences in outcomes.

The objective/research questions of the study were as follows:

1.2 Study Objectives:

1) To investigate the relationship of continuity of primary care physician with total hospitalizations and hospitalization for ambulatory-care-sensitive conditions (ACSCs)

2) To investigate the relationship of continuity of FP care with specialists contacts (including ambulatory specialist contacts and total specialists contacts)

3) To investigate the relationship of continuity of FP care with direct health care costs (including family physicians costs, specialist costs, total physicians costs and hospital costs)

4) To examine the effects of patient age on the relationship of continuity of family physician care with health care services utilization and costs outcomes by conducting analyses of different age groups, with particular interest in the elderly.

Summary of Remaining Chapters

Chapter 2 presents a literature review providing an overview of primary health care/primary care, continuity of care, pertinent research, and Andersen's Behavioural Model of Health Care Services Use, which is the conceptual framework used in the current study. **Chapter 3** provides a detailed discussion of the methods used to investigate the relationship of continuity of FP care with health care services utilization and with direct health care costs, while controlling for co-variates, as well as to examine the effects of patient age on these relationships. **Chapter 4** presents the findings of the current research study examining the relationship of continuity of FP care with health care services utilization outcomes and costs using two different samples: the Newfoundland sample of the Canadian Community Health Survey (CCHS) (Phase I) and the MCP registry sample (Phase II). Finally, **Chapter 5** provides a discussion of the study results and presents a modified conceptual model supported by the study findings. The chapter then discusses research contributions of the current study, its strengths and limitations, provides suggestions for improvements to study methodology and for future related policy-relevant research. Finally, the chapter provides some further policy implications and a conclusion.

CHAPTER 2: LITERATURE REVIEW

2.1 Outline of Literature Review

Given that the main purpose of the study was to examine benefits of continuity of primary care physician, the first section of the literature review gives an overview of primary care and primary health care including definitions, the four main attributes of primary care which are often used in its measurement and evaluation (of which continuity of care is one), the most common models or delivery methods for primary care used in industrialized countries, and a brief overview of recent primary health care reform in Canada, in which the most important theme has been the gradual replacement of traditional solo- and small-group practice family physicians/general practitioners with multi-disciplinary teams of primary care providers. Finally, general benefits of good primary care are discussed.

The sections following this provide the reader with an overview of the concept of continuity of care, including definitions, models of continuity of care which have been developed to study continuity care and understand its multi-dimensional nature, and the many measures of the different aspects of continuity of care. Next a review of the general benefits of continuity of primary care physician is provided along with more detailed reviews of the effects of continuity of care on the outcomes used in the present study -- namely hospitalizations, specialist utilization and health care costs. Given that another goal of the current study is to examine the effect of age on the relationship of continuity of care with outcomes, with specialist interest in the elderly, the next portion of the literature review provides a review of the literature on the relationship of continuity of primary care provider with health outcomes in the elderly and chronically-ill. In the next sections the reader is informed of the lack of research on continuity of care in countries with universally-funded health care such as Canada and then, given that administrative data is used in the present study to examine the research questions, a review of recent Canadian studies which have used administrative data to examine the relationship between continuity of primary care provider and health outcomes is provided.

The final section of the literature review provides an overview of Andersen's Model of Health Care Services Use which is used as a conceptual framework for the study and used to select appropriate co-variates. In this section a modified version of Anderson's model is proposed incorporating a visit-based measure of continuity of primary care physician and considering age as a modifying variable affecting the relationship of continuity of care with health services utilization and costs.

2.2 Primary Care and Primary Health Care

2.2.1 Definitions of Primary Care and Primary Health Care

Primary health care has many different definitions and interpretations. Although primary care is generally thought of as standing at the center of the health care system (Schoen et al., 2004), there is lack of consensus on what it refers to and its meaning is often a source of confusion. Vuori (1985 as cited in Starfield 1998) suggested four ways of viewing primary care: 1) a set of activities, 2) a level of care, 3) a strategy for organizing heath care, and 4) a philosophy that permeates health care.

The two terms primary care and primary health care are often used interchangeably. In general, primary care refers to medical care, which has as its main focus, actions to improve the health of the individual. However, research has identified the importance of the non-medical determinants of health and has shifted focus of primary care away from individuals to communities and populations. Primary health care is a philosophy and approach to health care, which acknowledges the importance of other determinants of health and the importance of healthy communities, as well as the idea that heath care alone cannot eliminate inequalities in health status. At the International Conference on Primary Health Care at Alma Ata in 1978, primary health care was defined as:

> *"…essential health care based on practical, scientifically-sound and socially-acceptable methods and technology made universally accessible to individuals and families in the community through their full participation and at a cost that the community and country can afford to maintain… forms an integral part of the country's health system, of which it is the central function and main focus, and of the community… the first level of contact of individuals, the family and community with the national health system bringing health care as close as possible to where people live and work, and constitutes the first element of a continuing health care process."* (Declaration of Alma Ata, 1978)

Health Canada (2008), defines primary health care as "an approach to health and a spectrum of services beyond the traditional health care system, which includes many other factors that play a part in health, such as income, housing, education, and environment". Primary care is defined as "the element within primary health care that focuses on health care services, including health promotion, illness and injury prevention, and the diagnosis and treatment of illness and injury" (Health Canada, 2008). In the United States, primary care has been defined by the Institute of Medicine (IOM) as "the provision of integrated, accessible health care services by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained partnership with patients, and practicing in the context of family and community".

Primary care is normally an individual's first point of contact with the health care system, and deals with common, often ill-defined problems, generally in community settings such as doctor's offices, health care centers, schools and homes (Starfield, 1998). It provides "person-focused care over time", provides care for all but the most uncommon and complex health conditions, integrates care and determines the work of all other levels of the health care system (Starfield, 1998). "Primary care often involves the assumption of responsibility for the patient regardless of the presence or absence of disease, and the integration of the physician, psychological and social aspects of health to limits of the capability of the health care professional" (Starfield, 1998). It provides "preventive, curative and rehabilitative services to maximize health and well-being". (Starfield, 1998), It is distinguished from secondary care, which is the service provided by medical specialists who generally do not have first contact with patients, and tertiary care, which is specialized care, usually by medical sub-specialties working in a center that has personnel and facilities for special investigation and treatment. Primary care is less intensive than specialty care and deals with a wider variety of problems (Starfield, 1998).

Levels of the health care system are often characterized by the type of physician providing care (Starfield, 1998). Primary care in Canada is generally provided by general practitioners or family physicians (FPs), mainly in solo or small-group practices, paid mainly on a fee-for-service basis. Along with nurses and some other staff, FPs deliver these services and manage referrals to other primary care services including diagnostic laboratory services, imaging services and support services and home help. "Primary care providers obtain patient information, integrate it with biomedical knowledge and decide on courses of action" (Bates et al., 2003) and act as gatekeepers to secondary and tertiary care. Primary care providers also play important roles in preventive care and treatment for acute and chronic conditions such as diabetes, asthma, heart disease and depression. In addition to FPs or general practitioners (GPs), primary care providers in Canada include nurse practitioners, nurses, pharmacists, dentists, social workers, psychologists as well as other health care providers. Receiving care from a FP, speaking with a nurse via a telephone help line or consulting a pharmacist about side effects of a medication are all forms of primary care.

In summary, primary health care has many different definitions and interpretations. The terms primary health care and primary care are often used interchangeably in the literature. Primary health care may be thought of as an approach to health and a spectrum of services beyond the traditional health care system, which includes many other factors that play a part in health, while primary care is defined as the element within primary health care that focuses on health care services. Primary care is normally the first point of contact with the health care system and often deals with common, often ill-defined problems in community settings. It care involves preventive, curative a rehabilitative services and also manages referrals to other primary care services including diagnostic imaging, laboratory services, support services and home help. In Canada has traditionally been provided by family physicians/general practitioners with the help of nurses and some other staff, but has more recently involved other types of heath care professionals.

2.2.2 Attributes of Primary Care

Starfield (1992) proposed a definition of primary care, which focused on four specific characteristics or attributes of primary care. The four attributes of primary care are interrelated, somewhat overlap with each other and may be difficult to differentiate. They have been used to evaluate or measure the efficacy of primary care.

The first attribute, "first-contact" refers to the fact that primary care acts as an individual's first point of contact with the health care system for each health problem or each time they seek health services. To this end primary care services must be accessible given that patients will use primary care to gain access to required health services. Accessibility consists of potential and realized access. Potential accessibility refers to such things as availability of health care personnel, facilities and wait times. Realized access refers to actual utilization and can be measured by utilizations rates (Aday, et al, (1980 cited in Blumenthal et al., 1995)). Primary care providers also are often charged with managing utilization of specialist care and decide whether or not patients should be referred, which is often referred to as a "gatekeeping" function.

According to Starfield, a second attribute of primary care is comprehensiveness, which refers to the role of primary care in ensuring that patients receive the full range of required health care services. This includes health promotion, prevention, curative care, referral to specialist care, hospitalization and other required services.

A third attribute of primary care is longitudinality, which refers to a patient seeing and maintaining a relationship with a health care provider, usually a primary care physician, over time. Ideally, the patient will come to trust the provider and the provider will feel a sense of overall responsibility for the patient's care over time. There are many measures of longitudinality, which include the duration of the patient-doctor relationship, number of doctors which the patient sees or the proportion of physician visits to the most-frequently-visited provider (Reid et al., 2002). Starfield (1998) distinguishes between the terms "longitudinality" and "continuity of care". Longitudinality refers to a sustained patient-provider relationship over time while continuity or care refers to "the sequence of visits in which there is a mechanism of information transfer". Continuity of care may occur through means other than by way of a sustained relationship with a primary care provider (i.e. provider continuity). Other mechanisms through which continuity of care may be achieved are described in a later section. Nonetheless, longitudinality or provider continuity is the most common way in which continuity or care is maintained in primary care. The current study will focus on the benefits of provider continuity.

The fourth and final attribute of primary care is co-ordination of care, which means that all aspects of patient's care are integrated such that they are appropriate, given at the proper time and in the correct sequence. Coordination ensures that patients receive the services they need and that they are connected across services and settings (Institute of Medicine, 1994). This might include other primary health care services, other levels of care, or other care settings such as community or home care. Traditionally, in primary care the primary care physician is most often responsible for co-ordination of patient care. More recently, however, primary care providers often work together in teams where sharing information between providers and levels of care can facilitate coordination of care. In other areas such as specialty care, management of a specific disease of a patient may involve care from multiple health care professionals, which has to be co-ordinated. Each provider has to be aware of the actions of other providers in caring for the patient so that care given is appropriate, properly timed, given in the correct sequence and neither missed nor duplicated (Reid et al., 2002). The coordination function of primary care is important as patients often do not know what services they require. Fragmentation of services can lead to unnecessary costs, for example, due to repeated unnecessary diagnostic tests (Romanow, 2002). Starfield (1998) notes that coordination requires some form of continuity, either by health care providers, medical records or both.

In summary, Starfield (1992) proposed a definition of primary care, which focused on four specific characteristics or attributes of primary care. The first, "first-contact" refers to the fact that primary care acts as an individual's first point of contact with the health care system for each health problem or each time they seek health services. The second, comprehensiveness, refers to the role of primary care in ensuring that patients receive the full range of required health care services. A third attribute, longitudinality, refers to a patient seeing and maintaining a relationship with a health care provider, usually a primary care physician, over time. Ideally, the patient will come to trust the provider and the provider will feel a sense of overall responsibility for the patient's care over time. Starfield (1998) distinguishes between the terms "longitudinality" and "continuity of care". Longitudinality refers to a sustained patient-provider relationship over time while continuity or care refers to "the sequence of visits in which there is a mechanism of information transfer". Longitudinality or provider continuity is the most common way in which continuity or care is maintained in primary care. The current study will focus on the benefits of continuity of FP care. The fourth and final attribute of primary care is co-ordination of care, which means that all aspects of patient's care are integrated such that they are appropriate, given at the proper time and in the correct sequence. In other areas such as specialty care, management of a specific disease of a patient may involve care from multiple health care professionals, which has to be co-ordinated.

2.2.3 Models of Primary Health Care.

In a policy synthesis for the Canadian Health Services Research Foundation, Lamarche et al (2003) provide taxonomy of four models of the organization of primary health care through analysis of cases of primary health care organization in industrialized countries. The four models are divided into two main groups, which differ in their vision of primary health care, either professional or community-oriented vision. In professional models, services are delivered mainly by physicians in solo or small group practices who do not report to a regional health authority and services provided are generally limited to preventive, diagnostic and curative services. The professional models are divided into two types, the professional contact model and the professional co-ordination model. The purpose of the professional contact model is to ensure accessibility of care to clients. The physician providing care is rarely associated with other health care professionals and there are no formal mechanisms which guarantee continuity of health care services over time or integration of services with other components of the health care system (Lamarch et al., 2003). The professional contact model is the most common primary health care model in Canada.

The purpose of the professional co-ordination model is to ensure continuity of primary health care services over time and thus, patients are usually required to register with a particular primary care organization. Physicians or nurses provide continuity of services and ensure needed follow-up and co-ordinate integration of care with other components of the health care system. Information technology is used to transfer clinical information to other levels of care and parts of the health care system.

Community-oriented models have a community approach to primary health care the goal of which is to "improve the health of specific geographically defined populations and to contribute to community development by providing a set of required medical, health, social, and community services" (Lamarch et al., 2003). These models are tied to health authorities and are designed to maintain or improve the health of a population in given geographic area. Services are delivered by care-giving teams consisting of health care providers from various disciplines who provide a broad range of " medical social and community services" (Lamarche et al., 2003). An example of community-oriented models is local community health centres (CHCs) in the province of Quebec. The community-oriented models are divided into the integrated community model and the non-integrated community models. In the integrated model the care team assumes responsibility for continuity of health care over time and information technology is used to transfer pertinent information to other parts of the health care system. In the non-integrated model there is no formal mechanism to ensure continuity of care and no use of information technology for integration of services (Lamarch et al., 2003).

In Newfoundland and Labrador, the most common model in urban areas is the professional contact model, while elements of the community integrated model are common in rural areas where working in interdisciplinary teams has historically been common probably due to the limited health care resources and widely-dispersed population.

In the review by Lamarch et al. (2003) all four primary health care models were ranked by both empirical observation and expert opinion in terms of their effects on the population. No single model provided all of the desired benefits. The highest-ranked model was the integrated community model, which provided the most benefit in effectiveness, continuity, quality and productivity (Lamarch et al., 2003), while the professional co-ordination model performed best in terms of accessibility and responsiveness. Thus, the optimal combination of models would be a combination of the integrated community model and the professional co-ordination model. Lamarche et al., (2003) recommend that the integrated community model be used as a benchmark for changing primary health care across Canada and that measures be taken to offset the model's short-comings with respect to accessibility and responsiveness.

In summary, Lamarche et al (2003) provide taxonomy of four models of the organization of primary health in industrialized countries. The models are first categorized according to their vision, either professional or community-oriented. In professional models services are delivered by physicians in solo-practice and are generally limited to preventive diagnostic and curative services. Community-orientated models are designed to maintain the health of a population in a given geographic area and services are delivered by teams of primary health care providers. The professional and community-oriented are models are, in turn, each divided into integrated and non-integrated models, thus giving four different delivery models. Integrated models have a formal mechanism(s) through which continuity of care is maintained (e.g. nurses responsible for follow-up or integrated information systems) whereas non-integrated models do not. In Newfoundland and Labrador the most common model of care the professional contact model. Lamarche et al. (2003) recommend that the community-oriented model be used as a bench-mark for changing primary health care across Canada.

2.2.4 Primary Health Care Reform

Since the 1970s there have been many reforms or innovations in primary health care in Canada involving alternatives to conventional fee-for-service solo and small group practices including changes in organization/governance styles, funding/ remuneration methods and different delivery arrangements such as broadening of the range of primary health care providers (Hutchison et al., 2001). In recent years there has been much debate about how primary health care services in Canada are organized including the lack of health promotion and continuity among different health care providers, problems with access in rural areas and shortages of health care providers

(Health Canada 2009a). In recent years, Canada's health care system has been closely scrutinized with a view to quality improvement and cost-effectiveness. Increasing costs, changing demographics and increases in chronic disease rates have resulted in initiatives to explore how the efficiency of the health care system can be increased (Health Canada, 2002).

The Health Transition Fund (HTF) was a $150 million fund, which from 1997-2001, supported 140 projects across Canada to test and evaluate innovative ways to deliver health care services within four priorities areas including home care, pharmaceutical issues, primary health care and integrated service delivery (Health Canada, 2002). It was a collaborative effort between the federal and provincial governments. The fund supported many primary health care pilot and evaluation projects throughout Canada including the Primary Health Care Enhancement Project in Newfoundland and Labrador. Over $3.5 million was provided over three years to set up locally-developed innovations in primary health care service delivery and continuing education of health care professionals at three sites which were chosen to be Twillingate, Port aux Basques and Happy-Valley Goose Bay (Primary Health Care Advisory Committee, 2001). Specific service education and research/evaluation goals were set for each site. Funded projects provided evidence that governments, health care providers, researchers and others can use in making informed decisions leading to a more integrated health care system (Health Canada, 2002).

The key feature of primary health care reform is the shift from solo FPs to teams of health care providers who are accountable for providing comprehensive health care services. There is growing consensus that primary health care teams will result in "improved access to services, more efficient use of resources, and better patient and provider satisfaction" with health care (Health Canada, 2009a). For example, the report of the Romanow Commission stated that "there is almost universal agreement that primary health care offers tremendous potential benefits to Canadians and the health care system… no other initiative holds as much potential for improving and sustaining our health care system" (Romanow, 2002). In 2000 the First Ministers agreed that improvements to primary health care were crucial to Canada's health care system and in 2003 the First Ministers established a Health Accord which set a target of 50% of Canadians having 24/7 access to a primary health care provider by 2011 (Health Canada, 2009b).

In response to the agreement about the need for improvements in primary health care, the Government of Canada established the $800 million Primary Health Care Transition Fund (PHCTF) which, from 2000-2006, provided support for transitional costs associated with new approaches to primary health care initiatives (Health Canada, 2009c). Funds were devoted to major provincial and territorial reforms as well as national and multi-jurisdictional initiatives related to advancing primary health care reform. There were five funding envelopes including a national funding envelope which supported projects of national significance and a provincial-territorial funding envelope of which Newfoundland and Labrador's share was $9.7 million. Although each jurisdiction undertook its own approach to reform, some common objectives of the PHCTF included increases in access to primary health care, increases in the emphasis on health promotion, disease and injury prevention and chronic disease management, establishment of multi-disciplinary teams, so that the most appropriate care is provided by the most appropriate provider, and to facilitate coordination with other health services (Health Canada, 2009c).

In 2003, the province released a provincial primary health care framework called "Moving Forward Together: Mobilizing Primary Health Care" (Government of Newfoundland and Labrador, 2003). This document included a range and balance of services designed to meet many of the above-listed objectives of the PHCTF promoting an interdisciplinary team-based approach to primary health care delivery with the goal of having primary health care teams provide services to at least 50% of the provincial population by 2010 (Health Canada, 2007).

In 2001, the Primary Care Advisory Committee was established in Newfoundland and Labrador to address physician concerns in response to a perceived crisis in primary care involving care delivery, recruitment, and retention of physicians, as well as service gaps and service withdrawals. The Office of Primary Health Care was established in 2002 in order to establish policy direction, implementation, and evaluation of primary health care reform initiatives and to manage funding of Primary Health Care teams. Teams were selected for funding through PHCTF funds based on submission of letters of intent. Provincial leadership support for primary health care teams was secured, and between April 2004 and March 2006, seven rural and one urban primary health care teams projects were funded in the province (Health Canada, 2007).

In summary, Canada's health care system has been closely scrutinized with a view to quality improvement and cost-effectiveness. Increasing costs, changing demographics and increases in chronic disease rates have resulted in initiatives to explore how the efficiency of the health care system can be increased and has fueled debate about how primary health care services in Canada are organized. The key feature of primary health care reform has been the shift from solo FPs to teams of health care providers who are accountable for providing comprehensive health care services. National funding programs such as the the Health Transition Fund and Primary Health Care Transition Fund have provided support for testing new approaches to primary health care initiatives and transitional costs in Canada. Primary health care reform has been a priority in Newfoundland and Labrador where the Primary Care Advisory Committee and the Office of Primary Health Care were created to established policy direction and oversee implementation of primary health care reform initiatives and later eight primary health care team sites were initiated in province.

2.2.5 Benefits of Primary Care

Effective primary care has been shown to have many benefits. Studies in the United States have shown that states with a higher ratio of primary care physicians to population had better health outcomes including lower all-cause mortality, cause-specific mortality for heart disease, stroke and cancer and infant mortality, low birth rate and higher rates of self-perceived health, even after controlling for possible confounders such as socio-demographics and lifestyle variables. (Shi, 1992; Shi 1994; Shi, 1999; Shi and

Starfield, 2000; Campbell et al., 2003). Similar results were found in studies in England (Gulliford et al., 2002; Gulliford et al., 2004). Areas in the US with a high ratio of primary care physicians to population also had lower health care costs than other areas in adult (Franks and Fiscella, 1998) and elderly populations (Welch et al., 1993; Mark et al., 1996) and better quality care (Baicker and Chandra, 2004). In contrast, supply of specialist physicians has been shown to be associated with higher mortality, higher costs and poorer quality care (Starfield et al., 2009; Baicker and Chandra, 2004). Costs of treating common illnesses such as community-acquired pneumonia were shown to be higher for specialists than for primary care physicians, even though patient outcomes were similar (Rosser 1996; Whittle, 1998).

Other studies have shown that people who have a primary care physician as their regular source of care have better health outcomes. A national survey in the US showed that people with a primary care physician rather than a specialist as their regular source of care had lower five-year mortality rates after controlling for many co-variates (Franks and Fiscella, 1998). In the US people receiving care from community heath centers (CHCs), which emphasize aspects of primary care, were found to be healthier and more likely to receive preventive care such as pap smears and vaccinations (Regan et al., 2003; O'Malley, 2005). In Canada children having ear, nose and throat surgery, who were referred to specialty care by a primary care physician, had better surgical outcomes and fewer complications compared to children who self-referred to a specialist (Roos, 1979). Health care reform to provide better primary health care in countries such as Spain, Cuba and Costa Rica, resulted in better health outcomes such as lower mortality rates due to heart disease, stroke and lung cancer as well as infant mortality (Starfield, 1998).

In addition, macro-level benefits of effective primary heath care systems have been demonstrated by studies using country as the level of analysis. The studies involved international comparisons where the health care systems of different countries were rated according to the four main characteristics of primary care discussed above. Countries with better primary care scores had better outcomes including higher birth weight, lower post-neonatal mortality, all-cause mortality, all-cause premature mortality and cause-specific pre-mature mortality from asthma and other chronic respiratory disease, pneumonia, heart disease and other cardiovascular disease (Starfield, 1991; Starfield, 1994; Starfield and Shi, 2002; Macinko, et al., 2003). Countries with stronger primary care, as measured by the same four attributes, also had significantly lower healthcare costs.

Finally, as previously stated, there has been increasing support for primary health care reforms involving a shift in delivery of primary health care services from solo-practice FPs towards multi-disciplinary team-based approaches. It has been argued that primary health care teams involving groups of health care providers being responsible for patient care may reap the benefits of "more eye and ears, the insights of different knowledge and a wider range of skills" and experience of team members (Wagner, 2000). Collaboration of different health care providers in the delivery of patient care has been proposed as the answer to many complex health care issues including growing resource constraints, increasing rates of chronic illnesses, and a growing and aging population

(Boon et al., 2009). For example the most effective chronic disease interventions involve a co-ordinated multidisciplinary care team where the primary care physician "delegates responsibilities to team members to ensure appropriate clinical and self-management support services" (Wagner, 2000). However, Reid et al. (2003) state that despite policy reports recommending shifts to primary care teams, there is relatively little evidence about the benefits and/or risks of a group of health care providers being responsible for patient care. The same authors caution that although teams may improve access and comprehensiveness of care, they may endanger other attributes of primary care such as continuity and co-ordination (Reid et al., 2003). More recently, however, a review of primary health care evaluation studies conducted for the Canadian Health Services Research Foundation concluded that collaborative models of primary health care involving primary health care teams can result in better patient satisfaction and outcomes, better provider satisfaction, knowledge and skills and more effective resource utilization (Barrett et al., 2007).

In a time of primary health care reform where solo practitioners are increasingly being replaced by primary health care teams, evidence supporting the value of traditional interpersonal care by a single physician is important for policy makers. Proving the value of traditional interpersonal continuity of care with a primary care physician would require demonstration of better outcomes or improved health care system efficiencies when this attribute of care is present. "Continuity of care is of value only to the extent that it has a [beneficial] impact on the outcome of care, the prevention or reduction of physical, mental or social disability, the satisfaction of patients or the cost of care" (Gonnella and Herman, 1980).

In summary, effective primary care has been shown to have many benefits. For example, in the US and Europe, areas with a higher ratio of primary care physicians to population have been shown to have better health outcomes such as lower all-cause and cause-specific-mortality as well as lower health care costs and better quality care, and people who have a primary care physician as their regular source of care demonstrate better health outcomes as well. At the macro-level countries with better primary care scores have been shown to have better health outcomes including higher birth weight, lower post-neonatal mortality, all-cause mortality, all-cause premature mortality and cause-specific pre-mature mortality from certain chronic illnesses. Despite increasing support for primary health care reforms involving a shift in delivery of primary health care services from solo-practice FPs towards multi-disciplinary team-based approaches, there is relatively little evidence about the benefits and/or risks of a group of health care providers being responsible for patient care. Some fear that, although teams may improve access and comprehensiveness of care, they may endanger other attributes of primary care such as continuity and co-ordination.

The current study focuses on the effects of continuity of primary care physician on health care services utilization and direct health care costs, thus we will next review in detail the definitions, and models of continuity of care and the benefits of continuity of primary care physician.

2.3 Definitions of Continuity of Care

Continuity of care is one of the defining attributes of primary care/family medicine (Hjortdahl, 1992; McWinney, 1997). Since Lee and Jones (1933 as cited in Raddish et al., 1999) wrote that "good medical care maintains a close and continuous personal relationship between patient and physician", continuity of care has been thought to be a critical aspect of healthcare and a fundamental tenant of primary care (Nutting et al., 2003; MacWinney, 1981). It has been defined as care experienced as "connected and coherent over time" (Reid et al., 2003 or an "uninterrupted succession of events" (Shortell, 1976). In the primary care literature, it is viewed as an "enduring relationship between a physician and a patient that extends beyond specific episodes of illness or disease" (Worrall and Knight, 2006) "the extent to which a single physician manages the health care needs of the patient", or "the sense of overall, direct and coordinative responsibility for the different medical needs of the patient" (Reid et al., 2002). There is, however, a lack of consensus on how continuity is defined and measured, especially across healthcare disciplines, which may impede the understanding of importance of continuity of care as well as research in the area (Reid et al., 2002). In fact, in a review of the literature on continuity of care Reid et al., (2002) found that only 32% of documents reviewed provided an explicit definition of continuity of care. In 48% the definition was implicit and in 20% the researchers were unable to infer the author's meaning of continuity.

To add to the confusion there are many other similar terms whose definitions overlap with continuity such as "continuum of care", "continuing care", "co-ordination of care", "case-management" and "discharge planning". Although they do not have exactly the same meaning they do contain some of the attributes of continuity of care. These terms are often used interchangeably with continuity in the literature and the distinction between them is often unclear (Reid et al., 2002).

2.4 Models of Continuity of Care

Continuity of care is generally thought of as a multi-dimensional concept and, over the years, researchers have developed multi-dimensional models of continuity of care in attempts to dispel confusion about the concept and recognizing different aspects of continuity. The models explain the different dimensions or types of continuity and possible mechanisms of action in affording benefits to patients.

Gulliford et al. (2006) briefly review the multi-dimensional models of continuity of care. One of the earliest multi-dimensional models of continuity was developed by Hennen (1975), which included four separate dimensions. These included a chronological dimension, which involved observation of the patient and/or illness over time; an interpersonal dimension which involved aspects of the relationship between the patient and provider over time as well as between multiple providers treating the patient; an interdisciplinary dimension, involving the aspects of care which cross over health care disciplines, and finally geographic dimension, which refers to provision of care regardless of the locality or health care site.

Bachrach (1981), a psychiatrist, wrote a review of continuity from a mental health perspective. She states that continuity of care "may be understood as a process involving the orderly, uninterrupted movement of patients among the diverse elements of the health care delivery system" and described seven dimensions of continuity some of which overlap with those of Hennen (1975). The relationship dimension referred to the relationship between patient and provider while the individual or patient-centered dimension referred to "care planned for the patient and his or her family". Comprehensiveness referred to ensuring that all of the patient's health care needs are met and flexibility referred to the adaptability of the health services to the changing needs of the patient. Accessibility referred to the patient being able to obtain services when needed and communication involves flow of information between patient and provider and among the different providers involved in the patients care. Finally Bachrach (1981) replaced Hennen's chronological dimension of continuity with a longitudinal or temporal dimension, which describes how different elements of care are "organized into a single course of treatment" over time.

Gulliford et al. (2006) state that although the models of Hennen (1975) and Bachrach (1981) are important, their weakness is their use of "terms which suffer from ambiguity or duplication". For example, Hennen (1975) uses the term "interpersonal" to refer to both the patient-provider relationship and to the relationship among the different care providers. A model proposed by Freeman et al. (2000) reduced the ambiguity and duplication of previous models by improving upon terminology (Gulliford et al., 2006). Freeman et al. (2000) described a multi-dimensional model of continuity of care where the central element was the "co-ordinated and smooth progression" of care over time from the patient's point of view. They state that in order to achieve this central element, five other elements of continuity are needed. These are: 1) Continuity of information, which involves transfer of patient information; 2) cross-boundary or team-continuity which involves effective communication between patient and provider and among providers; 3) relational continuity, which refers to establishing a therapeutic relationship with one or more providers; 4) flexibility as in Bachrach's model, which refers to adjusting to the needs of the patient; and 5) finally longitudinal continuity. However, Freeman et al (2000), unlike Bachrach (1981), used the term 'longitudinal continuity to refer to "care from as few health professionals as possible", which is consistent with how continuity is most-often understood in primary care (Gulliford et al., 2006).

Perhaps the most-well known literature review of continuity of care completed in Canada culminated in a report by Reid et al. (2002) commissioned by the Canadian Health Services Research Foundation, the Canadian Institute for Health Information and the Conference of Deputy Ministers of Health's Federal/Provincial/Territorial Advisory Committee on Health Services. The authors also published a brief 'multidisciplinary review' in the British Medical Journal (Haggerty et al., 2003). The research team synthesized many of the aspects of the earlier models of continuity of care identifying two core elements, which must be present for continuity to exist, and three types of continuity, which are present to some extent in all health care disciplines, albeit one or more types may be more salient in different health care disciplines (Reid et al., 2002).

The two core elements, which must be present for continuity of care to exist, are:

1) "the experience of care by an individual patient with his or her provider" and

2) "that care continues over time, which is often referred to as longitudinal or chronological continuity"

These elements are necessary but not sufficient for continuity to exist. With respect to the first element the authors state that "care must be experienced as smooth and co-ordinated for continuity to exist". This involves the interaction between the individual and the health care system, which distinguishes it from other aspects of care such as co-ordination, which involves interaction among providers (Reid et al., 2002). "Continuity can be thought of as "how patients experience integration of services" among providers.

The second element refers to establishing a relationship over time. The timeframe may vary from a single care event such as a hospitalization to a long enduring relationship developed with a care provider over time. Reid et al. (2002) indicate that the element of time also distinguishes continuity from other elements of care during a single care event such as "interpersonal communication". They state that the time element is meaningless unless linked to the three types of continuity, which I describe below.

Reid et al. (2002) define three types of continuity, which encompass the ideas brought forth in previous models. These are: 1) informational continuity, 2) management continuity, and 3) relational continuity. Informational continuity refers to the "availability and use of information on the patient and past events to support current care". Information about patient care and about the patient from a social context should be available to providers who need it. The information may be paper-based, electronic or in the provider's memory in the form of contextual information about the patient, over and above what is recorded in the patient chart or electronic health record. Two elements of informational continuity are information transfer and accumulated knowledge (Reid et al., 2002). It is necessary for information about the patient to be transferred to the provider who needs it. This is especially true in the discipline of nursing where the emphasis is on transferring patient information from one shift to the next in a hospital, or to community health nurses or other health care providers in the community, when a patient is discharged from hospital. This can be done through the patient chart, electronic information system or word of mouth. Thus, communication among providers is very important if care of a patient being administered by multiple providers is to be well-co-ordinated. In primary care, a way to facilitate availability of pertinent information about the patient is by maintaining a relationship with the same primary care provider, most often an FP, over time. The provider would have access to documented information about the patient as well as accumulate contextual information about the patient over time. A provider who has a long, enduring relationship with a patient would have most likely accumulated much more knowledge about the patient than would be stored in the patient chart or electronic medical record. "Knowledge of the patient's values, preferences, social context and support mechanisms" assist the provider in making better clinical decisions and providing better, more appropriate care to the patient (Reid et al., 2002) as well as allow for better outcomes such as patient satisfaction (Hjortdahl and Laerum, 1992).

The second type of continuity is management continuity which means that "separate types or elements of health care over time are provided in a complementary and consistent fashion so that required services are neither, missed, duplicated nor poorly-timed." (Reid et al., 2002). This type of continuity often applies to a specific disease or health problem, most often a chronic illness, which is being treated or managed. Reid et al. (2002) point out that the two main components of management continuity are consistency of care and flexibility.

Consistency of care often involves a management or care plan which is a "care pathway" which sets out or prescribes the way in which the separate elements of care should be administered over time in the proper sequence taking into account care goals. One way to achieve this in primary care is through seeing the same physician; however, this is not always possible. The type and seriousness of the health conditions being treated, as well as the length of time of prescribed care will determine the variety and quantity of the types of care needed and the number of providers needed to administer the care. The concept of management continuity here is similar to one of the attributes of primary care described previously by Starfield (1998), co-ordination of care, which refers to the integration of all of the care that a patient receives. Reid et al (2002), however, actually distinguish between co-ordination of care, which they refer to as the interaction of providers in caring for the patient, and management continuity, which is the patient's sense that the "care received from different providers is connected in a coherent way".

A second element of management continuity is flexibility, which means that care should be adaptable to the changing "needs, context and values" of the patient. This would include changes accommodating the deteriorating functional status of a chronically-ill patient, adapting care for an adolescent who is moving from pediatric to adult care, or moving from treating an aggressive cancer to palliative care of the patient (Reid et al., 2002).

The third type of continuity is relational continuity, also known as provider continuity, which refers to "an ongoing therapeutic relationship between a patient and one or more providers" which "bridges past and current care and provides a link to future care" (Reid et al., 2002). Two elements of relational continuity are an on-going patient-provider relationship and consistency of personnel. Starfield (1998) distinguishes between relational continuity, which is follow-up from one visit to another or the 'sequence of visits in which there is a mechanism information transfer' and 'longitudinality' which simply refers to the existence of a patient-provider relationship over time. These two terms are, however, often used interchangeably in the literature (Starfield, 1998).

Seeing the same provider over time and developing a close relationship with a primary care provider may have many benefits including facilitation of informational continuity for past care events and other pertinent information about the patient, a sense of affiliation with and trust in the doctor from the patient's perspective and a sense of overall responsibility for the patient from the doctor's perspective. This may lead to a mutual understanding and better communication between patient and provider and make it more likely for the patient to divulge pertinent information for care and adhere to treatment regimens (Starfield 1998; Reid et al, 2002). It will also allow the physician to have a better knowledge of the patient which allows for better problem recognition, diagnostic accuracy, and more appropriate use of medical/health care resources (Hjortdahl and Borchgrevik, 1991; Reid et al, 2002).

Even in instances where there may not be an expectation to develop an enduring personal relationship, consistency of personnel is preferred. For example, a patient would rather see the same provider than have to repeat their medical history and care expectations and preferences to several providers, or an elderly person may find it difficult to cope with different health care providers visiting them in their home (Reid et al., 2002)

Reid et al. (2002) state that the three types of continuity can be viewed from either a diseased-focused or person-focused perspective and from either a patient's or a provider's perspective:

> "*For patients and their families, the experience of continuity is the perception that providers know what has happened before, that different providers agree on a management plan, and that a provider that knows them will care for them in the future. For providers, the experience of continuity relates to their perception that they have sufficient knowledge and information about a patient to best apply their professional competence, and confidence that their care inputs will be recognized and pursued by other health care providers.*" (Haggerty et al., 2003).

Finally, a specific type of continuity may be more salient in one health care discipline than in others. For example, in primary, continuity of care most often refers to relational or provider continuity where the patient maintains a relationship with a primary care physician over time. In the nursing field the emphasis is on informational continuity including communication among nurses and transfer of patient information pertinent to care from shift to shift. Finally, in specialty care, where the focus is often the management of complex chronic illnesses, continuity often refers to care from multiple providers, which must often be co-ordinated in the proper sequence and timeframe where management plans and care protocols are very important (Reid et al., 2002).

2.5 Measures of Continuity of Care

The second part of the report on the review of continuity of care by Reid et al. (2002) reviews the different measures, which are available for measuring the different types of continuity. For the most part each measurement tool was developed to measure one type of continuity in a single context.

Measures of management continuity attempt to measure whether care is given at the appropriate time and sequence and is well-coordinated. One group of measures involves whether follow-up visits occur or the time that expires before follow-up. Another group of measures take into account whether a specific portion of a care management plan has been followed by providers (Reid et al., 2002). Indeed adequate follow-up has been linked to improved health outcomes (Reid et al., 2002).

Measurement of informational continuity deals with measures of information transfer and measures of uptake and use of information (Reid et al., 2002). Measures of information transfer involved measuring whether pertinent information about care has been documented (e.g. in the patient chart or electronically) as well as whether the information gets transferred to the new care level, organization or provider, for example when a patient is discharged from hospital into a nursing home, etc. Often the involvement of a case manager, or a visit from the provider in the receiving organization to the place of care from where the patient is being transferred, is taken as evidence of information transfer. Measures of information uptake and use include reviewing medical records to search for evidence that results of diagnostic tests were read or that patient's prior problems were acknowledged or followed-up (Reid et al., 2002). Patients can also be asked directly whether prior care records were available to the new provider, whether the new provider was aware of previous care history as well as whether they saw evidence of the new provider acting on the available information which had been transferred (Reid et al., 2002).

Measures of relational continuity include measures of affiliation and measures of strength of relationship (Reid et al, 2002). Measures of affiliation are the most common measures of relational continuity and provide evidence that the patient is seeing a provider regularly and/or has an established relationship with a personal doctor. These measures include simply asking the patient if they have a regular doctor (in most cases an FP), asking the name of their doctor or reviewing registration records or rosters in cases where patients have enrolled with a specific provider who is responsible for their health care (Reid et al., 2002). Measures of strength of the patient-provider relationship involve asking directly about aspects of this relationship such as "levels of communication, trust, as well aspects of the provider's behaviour and knowledge of the patient". Several well-validated, standardized instruments exist which measure these attributes as part of an overall assessment of primary care. These include the "Components of Primary Care", "Primary Care Assessment Tool" and the "Primary Care assessment Survey". These instruments have subscales, which measure attributes of the patient-provider relationship such as the "listening and communication skills of the provider, the provider's patience, friendliness, caring, respect, and knowledge of the patient", as well as the patient's trust in the provider.

Reid et al. (2002) also present a fourth category of measures of continuity of care, chronological measures, which could also be considered measures of relational or provider continuity. These measures capture aspects of the pattern of contact of the patient with health care providers over time and have the advantage that they often are easily obtained from readily available administrative health data. In Canada, administrative health databases contain information on insured health services provided by provincial governments, which include hospital discharges, physician billings, drug information and other health care service data. Continuity can be measured in terms of individual provider or in terms of site or primary care practice. In the former case a patient has perfect continuity if he or she sees the same physician at all visits, while in the latter, a patient is considered to have perfect continuity if he or she sees only physicians working at a specific practice site.

The authors state that these measures or indices, as they are often referred to, are often used as a proxy for measuring existence of the three types of continuity above. In other words, the use of these indices is based on the assumption that a repeated contact with a provider, or longitudinality, is indicative of presence of one of more of relational, informational or management continuity. The authors claim that there is little evidence to support such an assumption (Reid et al., 2002). However, since the review was published, measures of chronological continuity have been validated against a more direct measure of affiliation by Reid et al (2003). The researchers found high correlations between chronological measures of continuity such as the UPC, COC, and SECON and self-report of having a regular doctor using the 1998/99 version of Statistics Canada's National Population Health Survey in the province of British Columbia.

A systematic review of indices of continuity of care was conducted by Jee and Cabana (2006). The simplest of these measures include the duration for which the patient has been seeing the provider and the frequency of contact between patient and provider. More complex measures involve measures of concentration of care, which measure "how care is concentrated among the different providers seen". The crudest such measure is to simply count the number of providers seen (e.g. number of FPs) over a specified time period such as a year.

Many standardized indices of continuity of care have been developed, some with complex formulae, which are usually calculated from administrative health services data. Most indices have possible values ranging from '0' to '1'. A value approaching '0' indicates very low continuity of care where a different provider is seen at each visit, while a value of '1' indicates perfect continuity where the same provider is seen at all visits (Christakis et al., 2001). The simplest and most-common type of these indices is what Jee and Cabana (2006) refer to as continuity density measures. The most commonly-used of these measures is the Usual Provider Continuity Index (UPC) which is the proportion of total visits made to the usual provider. The usual provider can be specified by the patient or simply be the most frequently-visited provider. Most other density measures are variations of this index (Jee and Cabana, 2006).

The second most common are measures of dispersion which are measures which take into account the extent to which different providers are seen (Jee and Cabana, 2006). The most commonly-used of these is the Continuity of Care Index (COC) which is the measure of continuity used in the current study. It is described in more detail in the 'Methodology' chapter and the formulae for calculating it is given in Appendix F.

Another type of chronological index takes into account the sequence in which different providers are visited. The most commonly-used of these is the Sequential Continuity Index (SECON) which measures the proportion of consecutive visits to the same provider (Steinwachs, 1979).

There are also versions of indices which take into account the number of available providers as well as the total number of visits. Each index has its advantages and disadvantages. For example, the UPC index is simple to calculate, but only takes into account visits to the main care provider and its value is affected by utilization levels, often yielding falsely high values for people with a small number of visits. The COC index takes into account visits to all providers but may lack easy interpretation. Also, some indices are better suited for specific situations than others. For example Reid et al. (2003) suggest that the UPC may be more appropriate for policy makers because it is easy to calculate and interpret and requires minimal data. The SECON index, which takes into account the sequence of visits to different providers, is probably the most appropriate for studying transfer of information among providers.

Reid et al. (2002) point out that, given that no single measure can capture all aspects of continuity, multiple measures are needed in research projects in order to capture its different dimensions. Also, there are relatively few measures of informational and management continuity, specifically of information transfer and consistency of care across organizational boundaries. More of these measures need to be developed. Finally, given the current trend towards team-based health care, especially in primary care, measures of team-based continuity are needed which focus on the different aspects of how patient and team members interact and different aspects of team functioning such as such as communication, collaboration and transfer of information among care team members (Reid et al., 2002).

Finally and most-recently, Saultz (2003) reviewed definitions and measurement methods of continuity of care in primary care and provided a classification system of continuity of care with three dimensions or levels of continuity. He states that his model has an added advantage over the Canadian report by Reid et al. (2002) in that it "focuses attention on the relationship between the various dimensions" of continuity. Each successive level includes and builds on the level below it. The first and lowest level, informational continuity, refers to organized medical/social information, which is available to any health care professional caring for a patient. The second level, longitudinal continuity, refers, in addition to informational continuity, to a patient receiving care in an accessible and familiar environment from an organized team of providers (or from the same individual provider over time). The third level, interpersonal continuity, includes in addition to longitudinal continuity, an on-going relationship existing between a patient and a personal physician whom the patient has come to trust and who assumes responsibility for the patient's care (Saultz, 2003).

In summary, despite continuity of care being one of the defining attributes of primary care/family medicine, there is often a lack of consensus on how continuity is defined and measured, which may impede understanding of the its importance and research in the area. Generally, continuity of care is thought of as a multi-dimensional concept and, over the years, researchers have developed models to explain the different aspects of continuity, with each model improving upon its predecessors. Perhaps the most well-known model of continuity of Canada is that of Reid et al. (2002) which synthesizes aspects of previous models and described three types of continuity: informational, management and relational continuity. There are many measures of continuity, each of which is designed to measure a given aspect of continuity in a single context. The most common type of continuity measures used in primary care, and the type of continuity measure used in the present study, are measures of chronological continuity. These measures most often use administrative data to capture aspects of health care provider visit patterns, often a family physician, for a given individual.

2.6 Benefits of Continuity of Care

2.6.1 General Benefits of Continuity of Care.

Empirical evidence showing the benefits of continuity has been well-documented. Having a regular primary care provider has been associated with improved adherence to prescribed treatment, (Charney et al., 1967; Kelly and Shank, 1992; Safran et al.,1998), better recognition of unidentified health problems, (Becker et al., 1974a, Gulbrandsen et al., 1997) better rates of recommended preventive health care such as immunizations and cancer screening (Gordis, 1973; Christakis et al., 2000; Mainous et al. 2004; Fenton et al;. 2008), and improved patient satisfaction (Hjortdal and Laerum, 1992; Weyrauch, 1996), fewer hospitalizations, (Bauer et al., 1997; Gill and Mainous, 1998; Mainous and Gill, 1997; Christakis et al., 2001b; Cree et al., 2006; Knight et al., 2009) and emergency room visits (Christakis et al., 1999; Menec et al., 2005; Ionescu-Ittu et al., 2007), and to a lesser extent, reduced specialist visits (Starfield et al., 2009) and reductions in health care costs (Cornelius, 1997; De Maeseneer et al., 2003; Hollander et al., 2009). Several studies have noted fewer missed or broken appointments when continuity was provided; and, in a pediatric practice, an increase in the number of acute illness visits when continuity was reduced (Breslau and Reeb, 1975; Becker et al., 1974a). In some cases, continuity resulted in greater understanding by patients of their health and medical care (Starfield, 1998). For persons with asthma, continuity of care contributed significantly to communication with providers and better patient-rated levels of care (Love et al., 2000). A closely related outcome is patient and staff satisfaction (Caplan and Sussman, 1966) in Alpert et al., 1970); several studies concluded that patients and providers appear to be happier in continuity settings, and some have held that such satisfaction has an important beneficial effect on patient outcomes (Charney et al., 1967; Curry, 1968; Finnerty et al., 1973; Francis et al., 1969; Becker et al., 1974a; Poland , 1976; Wasson et al., 1984; Rowley et al.,1995; Baker et al., 2003).

Ettner (1999) found that patients in the US with a regular physician were three times more likely to have had a preventive health visit than those who did not; and increased compliance and cooperation with medical advice has been attributed to continuity of provider (Azzaretti et al., 1956; Charney et al., 1967; Kelly et al., 1992; Safran et al., 1998). Starfield also reports increased recognition of patients' problems when provider continuity is assured (Starfield and Sheff, 1972). Continuity of care has been held to increase physician knowledge of patients' needs and problems, reduce the likelihood of doctors duplicating previously-performed work as well as the number of diagnostic tests ordered and to reduce the likelihood of a doctor requiring a follow-up office visit (Heagarty et al., 1970; Breslau and Reeb, 1975; Breslau and Haug, 1976; Starfield et al., 1976). There is also evidence that the continuity of patient record may improve patient understanding of the diagnosis (Starfield and Sheff, 1972; Zukerman, 1975), and continuity of site can decrease hospitalization, illness visits and surgical procedures (Alpert et al., 1976).

Two recent critical reviews have examined the question of whether interpersonal continuity of care produces better outcomes for patients (Saultz and Albedaiwi, 2004; Saltz and Lochner, 2005). The first looked at interpersonal continuity of care and its relationship with patient satisfaction (Saultz and Albedaiwi, 2004). It found 22 original research reports, and 19 of these studies, which included 4 clinical trials, reported significantly higher satisfaction when interpersonal continuity was present.

Four randomized controlled trials showed a relationship between higher continuity of care and improvement in aspects of patient satisfaction in pediatric samples (Alpert et al., 1970; Alpert et al., 1976; Becker et al., 1974a; Becker et al., 1974b), elderly male veterans in the US (Wasson et al., 1984) and pregnant women in Australia (Rowley et al, 1995). However, most of the studies investigating the relationship between continuity and patient satisfaction were cross-sectional surveys or correlational studies in which determination of direction of causality was not possible. Studies often had flawed methodology such as failure to control for confounders, failure to measure continuity in intervention and control groups as well as inconsistencies in the way continuity and patient satisfaction were measured and considerable differences in studied populations. All of these factors make comparison of the study results problematic. Patient satisfaction was measured as overall satisfaction via a Likert scale or various aspects of patient satisfaction were measured including staff-patient interactions, clinic procedures, time spent with the patient, quality of care, confidence in the physician and patient participation in decision-making. For the latter, some studies used previously-validated instruments while some used non-validated interviews, and others only measured outcomes which could only be considered proxies of patient satisfaction such as wanting to change physicians or willing to wait in order to see a regular doctor (Saultz and Albedaiwi, 2004). Patient satisfaction was most often shown to be associated with visit-based measures of continuity of care such as the COC index used in the current study. No study found that continuity was negatively-associated with satisfaction.

The second review examined the relationship of continuity of care with clinical outcomes and health care-related costs (Saultz and Lochner, 2005). The authors state that although most previous reviews report a relationship of continuity of care with patient satisfaction, evidence that continuity of care improves outcomes and reduces costs is less conclusive. This review found 40 studies (41 articles), including 7 clinical trials that looked at the relationship between continuity of care and outcomes. The most common outcomes studied were preventive care, hospitalizations, quality of the doctor-patient relationship, chronic illness management indicators (reviewed in a later section) and maternity outcomes (Saultz and Lochner, 2005). In these studies 51 of 81 outcomes were significantly improved in the presence of higher interpersonal continuity of care. Only two outcomes significantly worsened with high interpersonal continuity. Roos et al (1980) found that interpersonal continuity was associated with lower likelihood of documentation of appropriate referral criteria for tonsillectomy and Gallagher et al (2001) found that women who saw both an FP or internist and an obstetrician were more likely to receive counselling for hormone replacement therapy. In the latter study, however, the independent variable does not appear to actually be a true measure of continuity of primary care provider. There was no association found with continuity for the remainder of the outcomes. The authors concluded, "Interpersonal continuity seems to be associated with improved delivery of preventive services and with lower rates of hospitalization, while improved measures of more specific health outcomes in chronic illness are less clear". A review by Cabana and Jee (2004) had similar conclusions to that of Saultz and Lochner.

Saultz and Lochner (2005) also claim to review 20 studies examining the association between interpersonal continuity and health care costs, including 5 clinical trials. A significant reduction was found in association with higher continuity in 35 of the 41 cost-related outcomes studied. Higher continuity was associated with an increase only two of these outcomes. Hjortdahl and Borchgrevink (1991) found that higher interpersonal continuity was associated with increased number of prescriptions and specialist referrals, although they found associated reductions in other outcomes. Most of the studies reviewed actually examine the association of continuity with hospitalization, emergency room and office visits, missed appointments and number of diagnostic tests (reviewed in a later section), which Saultz and Lochner (2005) refer to as "indirect cost measures". Most of these "cost " studies were actually included in the first portion of the review focusing on clinical outcomes and simply imply that the finding of association found between continuity and the particular health care utilization variable involved translate into an associated cost reduction. Only a small number of the studies reviewed actually examine the relationship between continuity and actual cost measures (reviewed in a later section).

Both review articles point to problems with comparing the results of the reviewed studies due to differing measures of both continuity and outcomes. The authors also caution the reader that given the observational nature of most of the studies reviewed, it is difficult to evaluate cause-effect relationships between continuity of care and outcomes. Both reviews indicated that the although the clinical trial studies which were reviewed involved random assignment of study participants to either low or high continuity groups, many do not actually measure whether continuity of care levels were actually higher in the experimental than in the control group.

Research findings involving the association of continuity of primary care physician with hospitalization, specialist referral and utilization, and health care costs are now reviewed in more detail given that these are the outcome measures used in the current study.

2.6.2 Continuity of Care and Hospitalization

In two studies of Medicaid (i.e. low-income) claims in Delaware, Mainous and Gill (1998) and Gill and Mainous (1998) and found reductions in likelihood of hospitalization of 44% and 25% respectively in people aged 0-64 with higher continuity of primary care provider. They did not report hospital savings in terms of number of hospitalizations. In the first study the authors also found that continuity of care was associated with a slightly higher reduction of 46% in hospitalizations for a subgroup of ambulatory care sensitive conditions (ACSCs) consisting of chronic illnesses, but there was no similar reduction found in hospitalizations for a second subgroup of ACSCs consisting of acute illnesses (Mainous and Gill, 1998). ACSCs are a group of health conditions for which effective outpatient care prevents or reduces the risk of hospitalizations (Billings et al., 1993). It is assumed that appropriate ambulatory care could prevent the onset of one or more of these illnesses or conditions, control an acute episodic illness or condition, or manage a chronic disease or condition. These health conditions vary somewhat in the literature but generally include chronic conditions such as heart failure, asthma and diabetes mellitus as well as more acute illnesses such as pneumonia and urinary tract infections. In the second study, the authors also investigate whether continuity at the practice site level would afford the same protection as continuity of individual provider, but the authors found that this group had hospitalization rates no different from those with low continuity (Gill and Mainous, 1998). An earlier study of a similar population by Gill (1997) found no association of continuity of care with likelihood of hospitalization, but found it was associated with a 35% reduction in hospital length of stay. In a US Medicare survey sample, Weiss and Bluestein (1996) showed a 29% reduction in hospitalizations and a 23% reduction in hospital cost while Cree et al. (2006) found an approximate 25% reduction in number and length of hospitalizations for those with higher continuity among patients with asthma, age 5-45 years, over a five-year period using administrative health care datasets in the Canadian province of Alberta. Using health maintenance organization (HMO) claims for a pediatric sample (age 0-18 years), Christakis et al. (2001) found 28% and 58% percent increases in hospitalizations for those in the medium and low continuity categories respectively, relative to those in the high category, as well as similar increase in emergency room visits (Christakis et al., 1999).

Using older samples, Wasson et al (1984) found a 51% reduction in emergency department admissions and a 60% reduction in hospital length of stay associated with higher continuity in men age 55 and over attending Veterans' Affairs medical clinics in the US while Smith (1995) showed a 28% reduction in hospital readmissions in a veteran's affairs hospital in the US. Menec et al. (2006) found 33% reduction in likelihood of hospitalization for ACSCs, but not in likelihood of hospitalization for any reason in a sample of older adults (age 67+) in Manitoba, Canada.

In another Canadian study in the Province of British Columbia Reid et al. (2003) examined the association of continuity of FP and hospitalization in one component of a series of studies using administrative health care data to study continuity of care of primary care provider. They examined continuity over a one-year period and measured hospitalizations over the following year. Although Reid et al. (2003) did not find an association of hospitalization with FP continuity alone, they did find an association when they "included specialist visits" in their continuity measures and "attributed them back to their referring FP" (Reid et al, 2003). After doing this they found an association of continuity of care with reduced hospitalizations and found "dose response" relationships where reductions in hospitalizations became larger with increasing continuity.

Continuity of primary care physician has also been found to be associated with reductions in hospitalization in both a sample of 1143 diabetics age 65+ in Newfoundland and Labrador in pilot research for the current study (Knight et al., 2009), as well as in a sample of diabetics of mean age 58 years in Taiwan (Lin et al. 2010).

2.6.3 Continuity of Care and Specialist Utilization

Relatively few studies have examined the association of continuity with specialist care. Using insurance claims for non-hospitalized individuals from several different regions in the US over a one-year period, Starfield et al. (2009) found that discontinuity of primary care physician was associated with an increase in number of non-hospital specialist visits. This increase, which became greater with age, amounted to an 8% increase for those 65 years and older, and an associated cost increase of $684 per additional specialist seen. This cost increase was also greater in the elderly. Using Medicaid claims, Joffe et al. (1999) found an increase in number of specialist and emergency department visits for children (aged 0 to 16) who switched primary provider site or physician group with doctor-switchers having about three times as many specialist visits as non-switchers (0.99 vs. 0.31 visits per year). In addition, Raddish et al. (1999)

found that patients seeing a higher number of primary health care physicians saw more specialists and had higher associated pharmacy costs, while Heagarty et al. (1970) demonstrated an association of improved continuity of care with a reduction in specialist referrals. Conversely, Hjortdahl and Borchgrevink (1991) investigated the association of previous knowledge of the patient with outcomes in a sample of patient from 133 general practices in Norway and found that doctors having good previous knowledge of the patient were twice as likely to refer the patient to a specialist and to prescribe a drug than if their previous knowledge was of the patient was scant (Hjortdahl and Borchgrevink, 1991).

2.6.4 Continuity of Care and Cost of Health Care Services Utilization

As previously stated, a number of studies have found continuity of primary care physician to be associated with reductions in health care service utilization measures and state that the observed reductions would most likely translate into cost savings for the health care system. Continuity-related reductions in emergency room visits, hospitalizations, hospital readmissions and length of hospital stay have been found in pediatric, adult and elderly populations (Christakis et al., 1999; Christakis et al., 2001; Gill, 1997; Gill and Mainous, 1998; Manious and Gill, 1998; Gill et al., 2000; Menec et al., 2006; Sweeney and Gray, 1995; Smith, 1995 Wasson et al., 1984; Weinberger, 1996). Studies have also found higher continuity of care and knowledge of the patient to be associated with reductions in laboratory tests, x-rays tests, prescriptions, and specialist visits and referrals (Heagarty et al., 1970; Hjortdahl and Borchgrevink, 1991; Starfield et al, 2009; Joffe et al., 1999), although Hjortdahl and Borchgrevink (1991) did find doctors with good previous knowledge of patients to actually be more likely to refer to a specialist and prescribe medication. One author suggests that "not only can a physician who knows his patients provide more personal and humane care, but he can also do it more cheaply" (Heagarty et al., 1970).

Studies investigating the association of continuity of primary care physician with direct health care cost are relatively few and their comparison is hampered by different measures of continuity and cost used in the studies. Starfield et al. (2009) demonstrated an association of higher continuity of care with increased specialist visits and showed that with each additional specialist seen, specialist costs increased by $683 and total health care costs increased by $747 per person per year. Two studies showed continuity to be associated with reduced total health care costs. De Maeseneer et al. (2003) showed provider continuity with a family physician to be associated with a 10.5% reduction in overall health care costs in an analysis of health insurance records in Belgium, while Cornelius (1997) found higher continuity of care to be associated with a one-third reduction in total health care costs in a US sample using data from the 1987 National Medical Care Expenditure Survey. Cornelius (1997) found that, specifically, continuity was associated with reductions in costs of dental services, prescriptions, physician visits and hospitalizations. Mitton et al. (2005) found the highest level of continuity of care of people with severe mental illness in Canada was associated with a one-third reduction in psychiatric hospitalization relative to the lowest continuity of care level in Alberta, Canada, while Raddish et al. (1999) found that US patients with selected chronic or acute health conditions seeing a higher number of primary care physicians saw a greater number of specialists and had higher pharmacy costs. Using data from a US Medicare beneficiary survey, Weis and Bluestein (1996) categorized the duration of ties of each patient with their primary care physician into five categories of increasing duration. It was found that those having the longest duration of ties to their physician (10+ years) had a reduced likelihood of hospitalization, a 23% reduction in hospital costs and a 22% reduction in medical costs relative to patients with the shortest duration of ties (<1 year). Finally, a Canadian study similar to ours, using administrative health data in British Columbia, found that in patients with diabetes and congestive heart failure with high use of health care resources, higher continuity of primary care practice was associated with reduction in total health care costs, a reduction which was mainly due to a decrease in hospital costs (Hollander et al., 2009). The researchers also found that cost reductions seen with higher continuity of primary care practice were greater in older people and were not present in individuals with lower health care resource utilization.

In summary, continuity of primary care provider has been associated with many benefits including improved adherence to prescribed treatment, better recognition of unidentified health problems, better rates of recommended preventive health care such as immunizations and cancer screening, and improved patient satisfaction, fewer hospitalizations, and emergency room visits, and to a lesser extent, reduced specialist visits and reductions in health care costs. Although reviews of continuity of primary care provider have generally shown that a majority of health-related outcomes were improved, it was found that continuity was mainly associated with improved patient satisfaction, improved delivery of preventive services, and lower rates of hospitalization. However, there are problems with comparing results of reviewed studies due to differing measures of continuity and outcomes and other methodological problems, and the observational nature of most studies in the area make it difficult to evaluate the cause-effect relationship between continuity and outcomes.

2.7 Continuity of Care and Vulnerable Populations

A vulnerable population has been defined as "a group whose demographic, geographic, or economic characteristics impede or prevent their access to health care services" (Blumenthal et al., 1995). These groups of patients may have difficulty establishing or maintaining continuity of care (Gulliford et al., 2006).

2.7.1 Continuity of Care in the Elderly.

One traditionally disadvantaged group is the elderly. Although seniors have benefited from government programs such as taxation policies and pension plans, and the financial security of seniors has been increasing, poverty among seniors still exists (Hayward and Colman, 2003). This is especially true of elderly women as they are more likely to have inadequate financial resources and to live longer than elderly men (Hayward and Colman, 2003). Contributing factors to low income may include low education levels or the loss of a spouse. Many seniors have a relatively low, fixed level of income and may find it difficult to keep up with the cost of living, home repairs, and increasing health care and drug costs. Furthermore, they may no longer be able to drive and have to pay for transportation such as taxis (Government of Newfoundland and Labrador, 2007). Seniors also experience many chronic illnesses such as cardiovascular and respiratory disease, degenerative conditions like osteoporosis and mental health problems such as Alzheimer's Disease (Hayward and Colman, 2003), which increase health care-related costs. It has been estimated that over 90% of those aged 65 and older in Newfoundland and Labrador have at least one chronic condition (Statistics Canada, 2005) and 13 of the 20 most common chronic conditions in Canada are linked to age (Gilmour and Park, 2005).

Given that the current study focuses on the elderly as a vulnerable group, with one of its main objectives being the investigation of the effects of age on the relationship of continuity of care with health care services utilization costs, we review evidence of benefits of continuity of primary care physician in the elderly here. Next, given the high prevalence of chronic illness in the elderly, we also briefly review the literature on the benefits of continuity of primary care provider in chronically-ill populations.

Even though the elderly are more likely to be hospitalized and to have preventive procedures and check-ups (Steven et al., 1998; Ettner, 1999) most studies examining the relationship between continuity of care and patient outcomes have been done on pediatric or adult populations (Alpert et al., 1976; Butler et al., 1985; Christakis et al., 1999; Christakis et al., 2001b; Gill et al., 1997; Gill and Mainous, 1998, Mainous and Gill, 1998; Menec et al., 2006). Although elderly people have been found to value continuity of care more than younger people (Kearley et al, 2001; Nutting, 2003) it is not known whether better continuity of care for seniors is associated with better health outcomes due to a lack of quality studies in this area. To our knowledge only two studies have investigated the effects of age on the relationship of continuity of care with health outcomes by conducting separate analyses of different age groups in the same sample. Starfield et al., (2009) recently conducted a study where discontinuity of primary care physician was found to be associated with increases in non-hospital specialist utilization and associated costs, increases which were larger for older people (Starfield et al., 2009), while Hollander et al. (2009) recently found that hospital and medical cost reductions seen with higher continuity of primary care practice were greater in older people with chronic illness. As the proportion of elderly people in the population of Canada increases (Statistics Canada, 2008), it is important to study the association of continuity of care with health care utilization and other health outcomes in this group in order to aid in determining whether they should be provided with high levels of continuity of primary care physician.

To investigate this question of whether continuity of FP care is associated with better outcomes in the elderly, myself and a colleague conducted a systematic review of studies of continuity of care in primary care for elderly people and found that although the literature on continuity of care generally suggests that continuity of interpersonal primary care is important and beneficial, specific evidence that it is beneficial for elderly people is scanty (Worrall and Knight, 2006). Only 5 good-quality studies in this area were found and results were conflicting as to whether continuity of care was important for the elderly.

In a randomized controlled trial (RCT) of 776 men ages 55 and older who were attending outpatient general medical clinics by Wasson et al. (1984), men in the single-provider intervention group were less likely to be admitted to the emergency room (20% vs. 39%) and to require ICU admission. Patients in the high continuity group had shorter lengths of hospital stay (15.5 vs. 20.5 days) and were more likely to report satisfaction with continuity of care as well as the physician's knowledge of the patient and thoroughness. There were no between-group differences in number of diagnoses, prescriptions, number of clinic visits or visits to other sites, number of diagnostic tests, or duration of physician visits (Worrall and Knight, 2006).

A second RCT by Coleman et al. (2001) examined continuity of primary care provider over a two-year period in a sample of chronically-ill patients aged 60 years and over who were members of a large health maintenance organization (HMO) in Colorado. One third of patients in the intervention group visited the emergency room vs. one-half of those in the control group and patients in the intervention group also had a higher number of emergency room visits (0.65 vs. 1.08). There were no between group differences in rates of primary care physician visits or hospitalizations, but no clinical outcomes were measured (Worrall and Knight, 2006).

A third study involved a survey of 1443 women age 50 to 65 years in Dutch general practice evaluating the effects of five years of continuity. Continuity was associated with better self-perceived health status. Patients with higher continuity felt healthier, reported fewer symptoms and had fewer physician visits. Fifteen clinical measures were assessed but only three differed between groups. Patients with higher continuity reported less congestive heart failure and chronic bronchitis as well as fewer hysterectomies (Huygen ey al. 1992).

In a retrospective analysis of 7362 Americans aged 65 years and older in an HMO, as previously mentioned, Weiss and Blustein (1996) found patients with ten or more years duration of ties with a primary care provider to be associated with a reduced likelihood of hospitalization, a ~\$300 (23%) reduction in hospital costs and a ~\$500 (22%) reduction in medical costs in a one-year period, mainly due to a reduction in emergency room visits, relative to patients with less than 1 year of ties. No between-group differences were found in number of flu shots or mammographies or in discussion of smoking or obesity.

Finally, in a study of almost 13,000 patients in six HMOs in the US with selected chronic or acute health conditions, as previously mentioned, Raddish et al. (1999) found that those seeing a lower number of primary care physicians saw fewer specialists and had a lower number of prescriptions and lower pharmacy costs than those seeing a higher number of primary care physicians. There were, however, no between-group differences in number of hospitalizations, outpatient cost or total health care costs.

In the review we concluded that "evidence that continuity of care is important for older patient is scanty". Studies demonstrating the importance of continuity of care have been mostly done in younger populations and it is uncertain whether and to what extent these findings can be extrapolated to elderly people. The studies presented here are difficult to compare to each other and to other similar studies because of the use of differing measures of continuity and outcomes. Also, the nature of the observational studies described here are not able to discern a causal relationship between continuity and the outcomes, and in only one of the two RCTs was continuity actually measured to insure that levels were actually higher in the intervention group. "It is possible that healthier people, more interested in prevention, seek out family doctors who provide continuity of care while, while sicker people are more likely to received acute episodic care" (Worrall and Knight, 2006). The review also pointed out that studies examining the effects of continuity of care have been mostly cross-sectional and involved process of care measures rather than measures of outcomes of care and that there is a need for long-term follow-up of these outcomes. There is also a need for more RCTs examining the effects of continuity of care on these outcomes but it is unlikely that this type of study will ever be done in Canada as patients are unlikely to agree to be randomly assigned to regular care or to a low-continuity situation (Worrall et al., 2006). Also, observable changes in health outcomes may require many years prospective follow-up, which may not be economically feasible.

Since the review by Worrall and Knight (2006), and the inception of the current study, there have been more studies that have investigated the benefits of FP continuity in the elderly including three studies in Canada using provincial administrative health services data. As previously mentioned, Menec et al. (2006) found 33% reduction in likelihood of hospitalization for ACSCs, but not in likelihood of hospitalization for any reason) over two two-years periods in a sample of older adults (age 67+) in Manitoba, while myself and a colleague showed an 18% to 25% reduction in number of hospitalizations in a sample of people age 65 in the three-year period after diabetes diagnosis depending on the continuity index used (Knight et al., 2009). Also, in a large primary care sample of people 65 and over in Quebec, Ionesu-Ittu (2007) showed that lack of a primary physician was associated with a 45% increase in emergency room visits and low and medium continuity of primary care provider to be associated with 27% and 45% increases in emergency room visits, respectively, relative to high continuity.

Continuity of primary care provider has also been shown to be associated with reduced all-cause-mortality in a nationally-representative survey sample of adults age 70 and older in the US (Wolinsky et al., 2010) as well as in a provincial sample of people with diabetes in Canada (Knight et al., 2010). Finally, having more primary care visits has been shown to be associated with fewer hospitalizations during end-of-life care (Kronman et al., 2008).

2.7.2 Continuity of Care in the Chronically Ill.

A chronic condition has been defined as "a condition which lasts 12 months or longer and meets one or both of the following conditions: a) it places limitations on self-care, independent living, and social interactions, or b) it results in the need for on-going intervention with medical products, services, and special equipment" (Perrin et al. (1993 cited in Friedman et al., 2006)).

Many studies of the effects of continuity of care on outcomes in the chronically ill deal with informational and management continuity involving primary care teams, specialty, and nursing care as well or in transferring from one level of care to another (e.g. being discharged from hospital into the community) (Smith, 1994; Anderson and Helm, 2000; Wagner, 2000; Eccher et al., 2006; Miller et al., 2009; Cowie et al, 2009; Dickerson and Sensmeier, 2010). Studies of continuity of care in mental health services have defined continuity of care in different ways including stability of the client-provider relationship, communication and co-ordination of care among providers, movement of the client in response to need, and maintaining contact with the client post-discharge or after referral (Adair et al., 2003).

Here we will concentrate our review on evidence for benefits of continuity of primary care physician in chronically-ill populations. Most studies of continuity of primary care physician and chronic illness have involved examining the association of continuity of care with outcomes in a sample of people with a particular chronic illness, with the most commonly-studied illness being diabetes.

Generally the role of the primary care physician in chronic illness is to provide preventive services, evaluate the patient and make the initial diagnosis, provide patient education and facilitate patient self-management of chronic illness, initiate treatment in less-complex cases, refer the patient to a specialist when needed and to co-ordinate overall patient care (Katon et al., 2001; Rothman and Wagner, 2003).

Continuity of primary care provider has been associated with reduced hospitalization for diabetic ketoacidosis in children with diabetes (Christakis et al., 2001) and with reductions in overall hospitalization in adult and elderly diabetic samples (Knight et al., 2009; Lin et al., 2010). Hollander et al., (2009) found continuity of primary care provider in people with diabetes to be associated with reduced health care expenditures, most of which was due to a reduction in hospital costs. Continuity of primary care provider in people with diabetes has also been associated with better patient satisfaction and well-being (Hanninen et al., 2001; Gulliford et al., 2007).

Evidence for other benefits of continuity of care in people with diabetes is conflicting. As stated above, Koopman, et al. (2003) found that people with a usual provider had a lower probability of having undiagnosed diabetes and Drivsholm and Olivarius (2006) found that patients with diabetes whom providers knew well presented with lower glycemic levels at the time of diagnosis than did patients whom they did not know well. They suggest that this may indicate that diabetes may be diagnosed earlier in patients with whom primary care physicians are more familiar. Broom (2003), however, found that more than half of patients with diabetes had their diabetes diagnoses under conditions of low continuity. While Koopman (2003) and Drivsholm and Olivarius (2006) concluded that continuity of primary care provider may lead to earlier diabetes diagnosis, Broom suggested that high continuity of care may "breed neglect" which may increase the time to diagnosis.

Gulliford et al. (2006) have reviewed the evidence for the association of higher continuity of care with diabetes monitoring and glucose control in people with diabetes, which is also conflicting. Some of the studies reviewed were included in the review of continuity of care and outcomes by Saultz and Lochner (2005) described above. The level of glycosylated hemoglobin (HbA_{1c}) in the blood is proportional to average blood glucose concentration. A blood test which measures HbA_{1c} level is often used in diabetes monitoring to assesses the effectiveness of therapy in lowering blood glucose. Some studies using visit-based measures of continuity of primary care provider have demonstrated an association of high continuity with better glucose control as assessed by HbA_{1c} levels (O'Connor, 1998; Parchman et al., 2002; Alazri and Neal, 2003; Mainous et al., 2004; Drivsholm and Olivarius, 2006), while other studies failed to find such an association (Overland et al., 2001; Sherina et al., 2003; Pereira et al., 2003; Gill et al., 2003). One study actually found higher continuity to be associated with higher HbA_{1c} levels (Hanninen et al., 2001).

While research has found higher continuity of care to be associated with improved diet (O'Connor et al., 1998; Parchman et al., 2002), regular home monitoring of blood sugar levels, more frequent HbA_{1c}, lipid and blood pressure checks, and more regular preventive foot and eye examinations (O'Connor et al, 1998; Parchman and Burge, 2002), other studies have failed to find associations of continuity of care with dietary control, glucose home-monitoring (Serina et al., 2003), blood pressure, lipid control, eye examinations (Overland et al., 2001; Gill et al., 2003; Mainous et al., 2004; Gulliford et al., 2007) or rate of diabetic complications (Overland et al., 2001). In addition, Gulliford et al. (2006) concluded that the quality of research studies in continuity of care in diabetes is limited due to methodological problems, such as a lack of explicit definitions of continuity and failure to control for confounding variables.

Studies have investigated the effects of continuity of primary care provider in populations with other chronic illnesses. Continuity of primary care provider in hypertensive patients has been shown to be associated with improved recognition of hypertension, lower incidence of hypertension, receipt of anti-hypertensive medication as well as fewer elevated blood pressure readings (Phillips and Shear, 1984; Konrad et al., 2005). However, Litaker (2005) found no association of continuity of provider care with control of risk factors for cardiovascular disease such as LDL cholesterol levels and hypertension and Peirera et al (2003) found that blood pressure was actually higher in hypertensive patients with higher continuity of primary care provider relative to those with lower continuity.

High continuity of care in people with asthma has been associated with decreased likelihood and number of ER visits and hospitalization in children and adults Christakis et al., 2001b; Cree et al., 2006) as well as improvements in characteristics of the physician-patient relationship, notably provider communication and patient influence on treatment (Love et al., 2000). Cyr et al (2006), however, found no association of continuity of care index values with ER visits or hospitalization. However, these authors did find that higher levels of continuity, as indicated by an index based on the number of new asthma prescriptions and prescribing physicians, was associated with reductions in ER visits and hospitalization.

Raddish et al. (1999) found that decreased continuity of primary care provider in a sample of chronically-ill individuals including people with arthritis, asthma, epigastric pain/peptic ulcer and hypertension was associated with greater specialist utilization and increased health care costs, and continuity of primary care provider has also been shown to be associated with reductions in hospitalizations for ambulatory care sensitive conditions (ACSCs) in samples of all ages (Mainous and Gill 1998; Menec et al., 2006).

Research has found continuity of primary care provider to be associated with increased rates of cancer screening and early detection of cancer, although evidence is somewhat conflicting. Studies have found continuity to be associated with increased likelihood of mammography, breast exam, pap smear, prostate specific antigen (PSA) test, focal occult blood test, and sigmoidoscopy (Kelly and Shank, 1992; Caplan and Haynes, 1996; Ettner, 1996; O'Malley et al., 1997; Lambrew et al., 1996; Xu, 2002; Doescher et al., 2004; Mainous et al., 2004; Fenton et al., 2008). Another study found no relationship of continuity with receiving a mammogram (Weiss and Blustein, 1996), while another has found that patients with high continuity actually had lower rates of sigmoidoscopy and colonoscopy (Fenton et al., 2008). Reid and Rozier (2006) found that continuity of primary care provider was associated with earlier diagnosis of cancer of the oral cavity while Mainous et al. (2004) found that trust in one's primary care provider, but not continuity of care, was associated with earlier diagnosis of breast and colon cancer.

Although, in the mental health field, continuity of care has been measured in many different ways and there is little consistency in the way that continuity is measured or in choice of outcomes (Adair et al., 2003), provider continuity has also been found to be associated with better outcomes in this area. Continuity of primary care provider in people with schizophrenia and other severe mental illnesses has been found to be associated with reductions in hospitalizations, hospital length of stay, emergency room services, and total health care costs, as well as with improvements in quality of life (Systema and Bergis, 1999; Chien et al., 2000; Reid et al., 2002; Mitton et al., 2005; Dixon et al., 2009). However, measuring continuity of care for people with severe and persistent mental illness is often hampered by inadequate or incomplete data sources especially for community mental health services (Reid et al., 2002).

While most studies of continuity of primary care provider include a measure of chronic illness/case-mix as a co-variate, only a small number of studies have demonstrated an increased importance of continuity of care for the chronically ill relative to the healthy individuals using in the same sample. Nutting et al., (2003) found people with chronic illness to place a higher value on continuity of care than healthy individuals, Love et al, (2000) found associations of continuity of care with improvements in provider communication and patient influence on treatment to be stronger for people with Asthma than for people without the disease, and finally, Hollander et al. (2009) found an association of high continuity of primary care provider with reduced health care costs to be stronger in patients with higher morbidity.

A final point is that there are currently very few studies of continuity of care in the long-term. Most studies of continuity have used time periods of only one or two years. Given the slow progression of many chronic illnesses, it is important to study the effects of continuity of care over longer periods (Lin et al., 2010). The present study examines the relationship of continuity with outcomes over a four-year period, which is a longer period than that used in most previous studies of continuity of care.

In summary, a vulnerable group is one whose characteristics impede access to health care. One traditionally disadvantaged group is the elderly. Even though the elderly are more likely to be hospitalized and to have preventive procedures and check-ups most studies examining the relationship between continuity of care and patient outcomes have been done on pediatric or adult populations. Although elderly people have been found to value continuity of care more than younger people it is not known whether better continuity of care for seniors is associated with better health outcomes due to a lack of quality studies in this area. Few studies have examined the effects of age on the relationship of continuity with heath outcomes by conducting analyses of different age groups. The elderly tend to have more chronic illness and research has shown continuity of primary care provider to be associated with better health outcomes in people with many different chronic illnesses such as diabetes, asthma and mental illness. As the elderly population increases it is important to study the association of continuity of care with health outcomes in this high-risk group.

2.8 Effects of Continuity of Care in Canada in a Universally-insured Health Care System

As many studies of continuity of care appear to have been done in the US, more research is needed to examine whether continuity of care is of benefit in a universally-funded health care system where access barriers are fewer, there are no user fees and people have free choice of provider as is the case in Canada (Menec et al., 2005). Following, we review studies that have investigated the effects of continuity of primary care physician in Canada, most of which have used administrative health data sources.

2.8.1 Use of Administrative Data for the Study of Continuity of Care in Canada

Although many studies of continuity of care have used self-reported measures of access and continuity which are often subject to biases (Weiss and Blustein, 1996; Ionescu-Ittu et al., 2007), over the years many indices of continuity of care have been developed, most of which measure the extent to which patients "concentrate their physician care and/or see the same providers over a succession of visits" and which are "geared toward administrative data" (Breslau and Reeb, 1975; Bice and Boxerman, 1977; Steinwachs, 1979; Reid et al., 2003). In most cases continuity of care indices are constructed from physician claims data. Administrative health data are population-based data which are routinely collected by governments and health care facilities, are inexpensive to use and can often be linked with each other and other data sources. They provide much more objective and accurate data on health care services use than self-reported data and are often able to provide complete health care service utilization profiles for a sample of individuals over a specified time period. Data linkage, in which different data sources are linked together via a common identifier such as health insurance number, allows for combining of administrative data sources which allows for much more powerful analysis than a single data set and expands research opportunities (Lazaridis, 1997).

In Canada, however, relatively few studies have used these data to examine the association of continuity of care and health outcomes, although the number has been increasing in recent years. Menec et al. (2005) conducted a study using a sample of 500,000 children and adults in Winnipeg, Manitoba and found that continuity of primary care provider, as determined by the usual provider index, was associated with better preventive health care and decreased ER visits. In a more recent study using a sample of 1863 older adults (age 67+) in Manitoba, Menec et al. (2006) found 33% reduction in likelihood of hospitalization for ACSCs. As previously mentioned, Cree et al. (2006) found an approximate 25% reduction in number and length of hospitalizations for those with higher continuity among patients with asthma age, 5 to 45 years, over a five-year period using administrative health care datasets from the province of Alberta. Ionescu-Ittu et al. (2007) conducted a study using a randomly-selected cross-sectional sample of just over 95,000 people age 65 and over taken from provincial administrative data in the province of Quebec. They found an association of decreased continuity of primary care provider with increased ER utilization amounting to a 27% increase in the medium continuity group and a 46% increase in the low continuity group, relative to high continuity (Ionescu-Ittu et al., 2007).

Reid et al. (2003) conducted a large study of continuity of care using a sample from provincial administrative health services data in British Columbia, which consisted of four component research projects. The first project focused on the measurement of continuity of primary care with administrative data and consisted of two sub-studies (Part A and Part B). In Part A, the researchers compared self-report of having a regular doctor as determined from the BC sample of the 1994/95 National Population Health Survey (NPHS) administered by Statistics Canada (n=2084) to index-based measures of continuity of care calculated using administrative data for one- and two-years periods. The researchers found a high correlation between four different indices of continuity of

FP care calculated from administrative data -- including the usual provider index, the continuity of care index and the sequential provider continuity index. It was also found that index values, categorized into continuity levels (e.g. low medium and high continuity) could be used to predict report of having a regular doctor in the NPHS data. A "dose-response" relationship was found where stronger associations were found for increasing levels of continuity.

It Part B of the first research project, the validity of continuity indices in predicting future hospitalization was investigated. In a 5% sample of the BC population (n=60,475), index values were calculated using one- and two-year periods and categorized into equal quintiles. The researchers examined the relationship of continuity of both FP care and specialist care separately with hospitalization but found no association. However, when they "attributed [specialists visits] back to their referring FP" a significant association of continuity of care with a reduction in hospitalization was found (Reid et al, 2003). Reductions in hospitalizations became larger with increasing continuity. Measures constructed over a two-year period generally had better predictive ability than those constructed over a one-year period.

In the second project the researchers investigated whether continuity of care measures were higher and more predictive of hospitalization when the indices were calculated such that the definition of perfect continuity was extended from continuity with individual FP to continuity with any FP in a large group practice (i.e. continuity of individual physician vs. continuity of practice site). About 70% of individuals received their care from the same physician. As expected, continuity improved (to about 81%) of people when the definition of continuity was extended to the level of the practice site. Continuity with individual physician was predictive of hospitalization with higher continuity being associated with a 9% increase in hospitalization in the lowest continuity quintile relative to the highest. Extending the definition of continuity to the practice site level was associated with little improvement in predicting hospitalization.

In the third project the investigators measured continuity of care for people with severe and persistent mental illness as well as testing the ability of these measures to predict hospitalization and mortality. Because of the large gaps in available administrative data for this population, physician claims and hospital data were combined with data from pharmaceutical payments, a mental health service database and mortality data. In general, models where continuity indices were used to predict hospitalization and mortality performed poorly. Continuity was a significant predictor of hospitalization only for people with severe mental illness who were on income assistance, with higher continuity being associated with a 24% reduction in hospitalization. The main conclusion from this project was that existing administrative data provide an inadequate source of data for assessing continuity of care for people with severe and persistent mental illness, mainly due to incomplete data in the pharmaceutical and mental health services databases.

In the fourth and final project, given that it had been found that health services utilization was higher in individuals in British Columbia who make injury claims to the Worker's Compensation Board relative to those who do not, Reid et al. (2003) compared continuity of care in those reporting injury claims to the Worker's Compensation Board in British Columbia in 1999 to a cohort of the general British Columbia population who were matched to the Worker's Compensation cohort for age, sex and region of residence. It was found that people reporting an injury to Worker's Compensation had lower continuity of FP care than the matched controls both before and after their workplace injury.

Overall the study provides support for the use of administrative data for measuring continuity of care given the acceptable concordance of these measures with survey based measures of a regular source of physician care. The study adds to the evidence of the benefits of continuity of care in reducing hospitalization and in the possible prevention of injury and reduction in time away from work in the working population. It also illustrates that available administrative data may not be adequate for the study of continuity of care in all populations.

Another study of continuity of primary care in British Columbia examined the relationship of attachment to a primary care practice (i.e. continuity of practice site) with medical, hospital and drug costs using analysis of administrative data (Hollander et al., 2009). The researchers found an inverse relationship between continuity and costs, but only for individuals with higher care needs. They used the case-mix system developed by Johns Hopkins University involving adjusted clinical groups (ACGs), which take into account age, sex and number and type of diagnoses of the patient in order to provide a measure of 'burden or morbidity' (Hollander et al., 2009). Resource utilization bands (RUBs), are larger aggregates of the ACGs which provide an indicator of health care resources utilization. They range from healthier people in RUB 0 (non-users) to RUB 5 (very high resources users) (Hollander et al., 2009). The researchers found that there was no relationship of continuity of practice site with cost in RUBs 1 or 2, a moderate inverse relationship for RUB 3 and a strong relationship for RUBs 4 and 5 where high continuity of practice site was associated with a reduction in total health care costs, most of which were related to reductions in hospital cost. The study presents separate data for people in RUBs 4 and 5 with diabetes and congestive heart failure. In very-high-care-needs diabetics, continuity of practice was associated with an approximate $11,000 (~65%) reduction in hospital cost per-year for those in the highest continuity group vs. those in the lowest continuity group, while the reduction was even larger for those with congestive heart failure (Hollander et al., 2009).

Finally, in a study which served as the pilot for the current study, we used a sample of 1143 newly-diagnosed diabetics aged 65 and over selected from the Newfoundland and Labrador component of the National Diabetes Surveillance System and found continuity of family physician care, as measured by three continuity of care indices, to be associated with as much as a 25% reduction in hospitalization over the three-year period after diagnosis, depending on the index used (Knight et al., 2009).

In summary, although most research on continuity has been dome in the US and there is a lack of research on continuity of care in countries with universally-funded health care such as Canada, several recent Canadian studies using administrative data have demonstrated a relationship of better continuity of primary care physician with improved health outcomes.

2.9 Conceptual Framework - Anderson's Model and Proposed Modified Model

From a theoretical perspective the current study uses Andersen's behavioural model of health care services utilization which suggests that there are a wide array of variables that impact on an individual's use of health services utilization, mainly predisposing characteristics of the patient, enabling resources and need factors (Andersen, 1995). In the current study several of these variables, available in the CCHS and MCP databases, are used as control variables in the multivariate analysis used to model the relationship of continuity of care with health care services utilization and costs. For purposes of the study, continuity of care will be considered an enabling resource.

Andersen's behavioural model is the most widely-used conceptual model for explaining variation in the use of health services and has been used to study access to many different types of health services (Fan et al., 2010) including physician (Wolinsky and Coe, 1984; Nabalamba and Millar, 2007), psychiatry (Smith, 2003), hospice (Miller, 2007) and hospital utilization (Wolinsky et al., 1994). The model was originally developed in the 1960s to predict and explain the use of "formal personal health services" by the individual (Andersen, 1995), has been subject to much criticism over the past 40 years, and as such, has undergone several revisions or phases (Andersen, 1995; Andersen, 2008; McDonald and Conde, 2010). The initial model focused on three groups of population factors as determinants of health services use which, as stated above, were predisposing characteristics, enabling resources and need factors.

According to the initial behavioural model, predisposing characteristics predispose people to use health services. These include demographic characteristics such as age and sex, social structure (e.g. ethnicity) and health beliefs. The latter are people's "attitudes, values, and knowledge" about health and health services, which may influence their perception of their health status or their perceived need of health services (Andersen, 1995).

Enabling resources are personal or community resources, which facilitate or inhibit use of health services such as income, education, rural-urban status and distance to health care services, wait times, health insurance coverage and presence of a regular source of care (Andersen, 1995; MacDonald and Conde, 2010). The main predictor variable of interest in the current study, continuity of FP care, may be considered as part of this group of determinants of health care services.

Finally, need factors are those which determine the individual's need for health care services. These include both perceived and evaluated need. Perceived need deals with a person's self-perceived health status and how they can cope with the symptoms of a disease (Andersen, 1995). Evaluated need refers to assessment of the individual's health and need for health care by a physician or other health care provider and includes such measures as chronic illness diagnoses (Andersen, 1995).

The subsequent phases of the model are summarized in Andersen (2008). In Phase 2 of the model, used in the 1970s, three aspects of the health care system: health policy, resources and organization, were included as determinants of health care services use, and patient/consumer satisfaction was included as an outcome or result of health services use. Although need factor have been found to be the most important determinants of health care services (Fan et al., 2010), in this phase of the model it was recognized that, of the determinants in the model, enabling factors are the most mutable or amenable to change and, thus, are the most important determinants from a policy perspective.

Phase 3 of the model, used in the 1980s and early 1990s, recognized that health-related behaviours of the individual (e.g. diet and exercise) could influence health services use and, thus, these were added to the model as enabling factors. In this phase of the model it was also recognized that health outcomes were in part a result of health services use. Thus, both perceived and evaluated health status were added to the model as outcomes along with patient satisfaction, which had been added in Phase 2.

Phase 4 of the model identified the "dynamic and recursive nature of the health services use model" and added feedback loops recognizing that health outcomes could, in turn, affect predisposing, enabling, need and behavioural factors and ultimately influence subsequent health services use. Finally, in Phase 5, contextual factors were added to the model. These are factors, which are "measured at a more aggregate level" than individual population characteristics (e.g. community or organizational level factors). Sub-groupings of contextual factors are the same as those of the population (individual) characteristics described in Phase 1: predisposing, enabling and need factors. Finally, in this phase medical care (i.e. behaviour of providers) was included as a health behaviour, which may influence health services use (Andersen, 2008).

McCusker et al. (2003) and Gruneir et al, (2010) propose a modification of Andersen's model to explain ER use in elderly people where they point out that underlying medical conditions should be monitored and controlled through primary care services to prevent exacerbation or complications. In the model access to primary care services is considered an enabling factor where inadequate care can result in increased ER use. Fan et al., (2010) tested a similar model but failed to find an association between ER use and continuity or primary care in the rural elderly, as measured by whether or not a person had a regular source of primary care. They argue that the reason why they failed to find an association was that their measure of continuity was limited a yes/no question indicating the presence or absence of a regular source of primary care and did not include information on how often or effectively individuals utilization their usual source of care, which they point out has been "carefully examined" in some other studies using more sophisticated measures of continuity of care such as continuity indices, most of which were included in the literature review above (Gill and Mainous, 2000; Rosenblatt et al., 2000; Menec et al., 2005; Ionescy-Ittu et al., 2007).

We propose a similar modified version of Andersen's model (See Figure 2.1) where continuity of FP care, as measured by the Continuity of care index, is considered an enabling factor predicting hospitalizations and specialist utilization and associated costs in groups of all ages. We also control for number of FP visits. Furthermore, given that older people tend to have more chronic illness (Hayward and Colman, 2003; Gilmour and Park, 2005) and that there may be an "increased importance" of primary care in the elderly due to this fact (Menec et al., 2006), we propose that age acts as a moderating

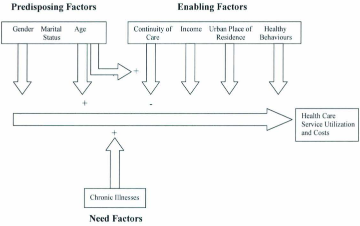

Figure 2.1 Proposed Modified Model

variable affecting the relationship between continuity of FP care and health services utilization. Thus, we hypothesize that higher continuity of care will be associated with reductions in health care services utilization and that the association of continuity with health care services utilization will be stronger at older ages, thus resulting in greater reduction in health care services utilization at higher age groups.

The variables used are as follows (See Figure 2.1): 1) Predisposing factors are gender, age and marital status. 2) Enabling factors include income, rural/urban residence and healthy behaviours including: physical activity level, fruit and vegetable consumption as well as smoking and drinking status. Continuity of care (i.e. regular source of care) was also considered an enabling factor for purposes of the study and analyses also controlled for the number of FP visits. 3) Need factors included number of chronic illnesses.

In summary, Andersen's Behavioural Model of Health Services Use, the most widely-used conceptual model for explaining variation in health care services use, was used as a conceptual framework for the present study. The model describes three groups of population characteristics which influence health care use: predisposing characteristics, enabling resources, and need factors. Analyses used in the current study include at least one variable from each of the three groups. We have proposed a modified version of Andersen's model where continuity of FP care, as measured by the Continuity of Care Index, is considered an enabling factor in the model and age acts as a moderating variable affecting the relationship between continuity of care and health services utilization and costs.

CHAPTER 3: METHODOLOGY

3.1 Introduction

The purpose of this chapter is to provide a detailed discussion of the methods used to investigate the relationship of continuity of FP care with health care services utilization and with direct health care costs, while controlling for co-variates, and to examine the effects of patient age on these relationships. The study uses individual-level data for two representative samples of the province of Newfoundland and Labrador (NL), Canada, each from a different data source. This chapter provides an overview of the (i) study design (ii) study population/sample, (iii) data sources (iv) data linkage process (v) study measures used (vi) determination/calculation of variables used in the analyses, (vii) study procedure, (viii) data analysis and, (ix) ethical considerations.

3.2 Study Design

This is a population-based study with two main phases, each involving of a separate sample data source. Phase I uses the Newfoundland and Labrador (NL) sample of the Canadian Community Health Survey Version 1.1 (CCHS 1.1) (2000/01) while Phase II employs a sample from the Medical Care Plan (MCP) registration file (or beneficiary file) (2003) which is the Provincial health insurance registry. In each phase, sample records are linked via health insurance number (MCP number in Newfoundland and Labrador) to two provincial administrative health databases in order obtain objective HSU profiles for each study subject, thereby obtaining information on levels of continuity of FP care and study outcome variables. Phase I involved the following sub-analyses:

i) Descriptive statistics and bi-variate comparisons of health care service utilization outcomes and co-variates by level of continuity of FP care.

ii) a predictive analysis using multivariate modeling in order to examine the association between continuity of FP care and health care service utilization measures, controlling for co-variates,

Sub-analysis i) and ii) above were also conducted for separate age groups in order to examine the effect of age and chronic illness on the relationship between continuity of FP care and health care service utilization measures.

Phase II of the study involves the same three sub-analyses plus a similar set of sub-analyses examining the association of continuity of care with health care cost outcomes, as well as the effects of age on this relationship

Analyses are described in more detail in the 'Analysis' section following.

3.3 Study Population/Samples:

Phase I utilizes the Newfoundland and Labrador sample of the Canadian Community Health Survey version 1.1 (2000/01), records of which are linked to provincial fee-for-service physician, and acute (in-patient) hospital separation data. Only those with at least 3 FP home or office visits were included in the final sample in order to be able to calculate continuity indices. Also, patients with place of residence in the former Labrador Health Corporation and Grenfell Regional Health Services Board were excluded due to a low proportion of fee-for-service physicians in these regions (See Table 3.1), and thus low representation in the fee-for-service physician database.

Between 2000 and 2001 Statistics Canada's cross-sectional Canadian Community Health Survey Version 1.1 was administered to 131,535 Canadians through personal interviews conducted by telephone or in-person representing an 84.7% response rate. The survey used a multi-stage cluster sampling design to collect information related to the health of non-institutionalized individuals and included household residents aged 12+ in all provinces and territories; excluding persons on Indian Reserves, Canadian Forces Bases, and some remote areas. The total sample size was sufficient to provide reliable cross-sectional estimates at the provincial or health region level (Beland, 2002).

Data on survey respondents was extracted from the Newfoundland and Labrador portion of the Canadian Community Health Survey (2001) Share file (see description of CCHS files below). Inclusion criteria for the CCHS sample included that the participant agreed to:

1) Share his/her survey responses with Statistics Canada/Health Canada and other health information agencies;

2) Gave permission to link individual survey responses with other provincial health information databases, and

3) Provided a valid Newfoundland and Labrador provincial health insurance number (MCP number) for linkage purposes.

Phase II utilizes a random sample of 80,000 records (i.e. individuals) from the Medical Care Plan (MCP) registration file (2003), which is an electronic file maintained by MCP within the Provincial Department of Health and Community Services containing names and demographic information on all individuals eligible for provincial health insurance coverage. The file contains just over 500,000 records. The goal was to obtain a sample of 10% (~ 50,000) of the Newfoundland and Labrador population. As in Phase I, records selected were linked to provincial fee-for-service physician and acute (in-patient) hospital separations.

The CCHS 1.1 and MCP registration file provided two samples representative of the population of NL both providing information on socio-demographic and health status variables. The CCHS sample used for Phase I contains a large, rich set of co-variates including lifestyle variables, but the sample size is relatively small. Whereas the MCP claims file used in Phase II allows for a much larger sample size and thus more statistical power, but has a much smaller set of co-variates available for analysis. Thus, each of the

Table 3.1: Physicians Registered with MCP and Percentage of Physicians Paid by Fee-for-Service, by Health and Community Services Region

HCS Region	Number of Family Physicians	Number of Specialists	Percentage Fee-for Service	
			Family Physicians	Specialists
Health and Community Services – St. John's	155	221	91.6	78.3
Health and Community Services – Eastern	131	73	66.4	32.9
Health and Community Services – Central	52	22	61.5	77.3
Health and Community Services – Western	68	58	60.3	51.7
Health Labrador Corporation Labrador & Grenfell Regional Health Services Board	38	29	28.9	13.8
Other	0	2	0	100
TOTAL	**444**	**405**	**70.5**	**61.7**

Notes:

1) Data compiled from MCP Annual Report, 1999/00

2) Data for Labrador and Grenfell boards are combined as physician data for St. Anthony (Grenfell Board) and Goose Bay (Labrador Board) are combined in the MCP Annual Report

3) Full-time teaching physicians are excluded

two phases have benefits and drawbacks and their results were intended to complement one-another in investigation of the research questions. The administrative health databases provided objective measures of health services utilization. Data sources are described in detail in the next section.

3.4 Data Sources

The research study used three main data sources to answer the research questions: (i) the Newfoundland and Labrador component of the CCHS 1.1; (ii) the Medical Care Plan databases (registration file and physician claims file) and (iii) the Clinical Database Management System (CDMS).

3.4.1 The Canadian Community Health Survey 2000/01

The CCHS is an interviewer-administered survey developed by Statistics Canada to address gaps in information at the regional level and to explore health issues and healthcare concerns of Canadians. The survey commenced in 2000/2001 and is repeated every two years. The primary objective of the CCHS is to provide timely cross-sectional estimates across provinces on health determinants, health status and health system utilization. Survey results provide a "snap-shot" of the health status, health determinants and self-reported health care services utilization of the residents of the provinces and territories, and provide health information for governments, health boards, health agencies, researchers and communities to inform health policy decisions, research and the development of programs. The CCHS 1.1 took approximately 45 minutes to complete. It included: thirty minutes of "common content" questions asked to all sample units, in all provinces to meet the basic health data requirements on an on-going basis; ten minutes of questions on "optional content", modules offered to the provinces at an additional cost. Buy-in to the "optional content" questions are decided by individual provinces from a predefined list of questionnaire modules. Standard questions on socio-economic and demographic characteristics complete the interview. The survey questionnaire and comprehensive information about the survey is available on the Statistics Canada website (Statistics Canada, 2009).

The following variables were extracted from the CCHS for each survey participant: household ID, person ID (combined to from respondent ID), survey date, age, gender, marital status, income adequacy, rural/urban status, smoking status, drinking status, physical activity level, and number of chronic conditions. Variables are described in Appendix A.

3.4.1.1 Access to Survey Data

Statistics Canada stores and maintains its survey data in several files, two of which include a "Master file" and a "Share file". In addition, a 'Link ID file' can be accessed in order to link individual survey responses from either the Master or Share files with other individual-level health information, such as that from administrative health care services databases.

3.4.1.2 Master file

The Master file includes survey responses for all survey participants including individuals who have not agreed to share responses. This file includes survey responses and identifying information such as names, addresses and telephone numbers for all respondents. If a researcher(s) can show that access to the Master file is required for research purposes and the other survey files (e.g. Share File) do not provide the needed information, access to the Master File can be provided through the Research Data Centres Program or remote access but the Master File is not permitted to be taken off-site. Researchers are able to submit research questions and required analysis by email. Analysis is performed by the staff of Statistics Canada and results returned to the researcher.

3.4.1.4 Share file

Statistics Canada provides a national "Share file" to each provincial ministry of health and other 'share' partners. The Share file is stripped of all personal identifiers and is available for research purposes. It contains survey responses and information on only respondents who have agreed to share their responses with other jurisdictions (e.g. other health regions and other provinces).

3.4.1.5 Link ID file

For those survey respondents who agree to allow the linkage of their survey responses to other health information agencies through the provision of their health insurance number, a "Link ID file" is produced and provided to provincial ministries of health. The link ID file contains the CCHS 1.1 Share file 'household ID' and 'person ID', which together create a unique identifying variable as well as provincial health insurance number (MCP number in NL), which can be used to link the Share File records to other individual-level data sources. The file also contains other personal identifiers such as name, age, sex, date of birth and address information for each survey respondent. The Newfoundland and Labrador CCHS 1.1 Link ID file is housed at the provincial Department of Health and Community Services. The Newfoundland and Labrador Centre for Health Information (NLCHI) has an agreement with both the provincial Department of Health and Community Services and Statistics Canada to access this file. The present study utilizes both the Share and Link-ID files.

3.4.2 Medical Care Plan Databases

The Medical Care Plan (MCP) is a comprehensive system of public medical care insurance that covers the cost of physician services for eligible residents of the province of Newfoundland and Labrador, landed immigrants and some foreign workers employed within the Province. The two MCP databases utilized in the study are housed within the Provincial Department of Health and Community Services. The databases are:

3.4.2.1 MCP Registration (Beneficiary) File:

This file contains names and limited demographic information for all people eligible for provincial health care insurance coverage. Variables extracted from this file were MCP number, date-of-birth and postal code of residence (See Appendix B).

3.4.2.2 MCP Physician Claims file

This MCP file is the most-extensively-used file of the three for the present study. It contains information on all fee-for-service physician claims in the province and captures information on sex and age of patient, main diagnosis, provider's specialty (e.g. general practitioner or other specialty), service date, fee code, cost of main service provided, and cost premiums charged. The MCP fee code describes the main service provided to the patient and can be categorized into one of several categories including: office consultations, home consultations, in-patient consultations, outpatient and emergency consultations, diagnostic and therapeutic procedures, in-hospital diagnostic procedures, radiology and surgical procedures. The fee code, associated costs and any premium(s) (additional fees which the doctor is permitted to charge under certain circumstances), are set by the Medical Care Plan Board.

Only records where the physician was coded as the primary provider were included in the study. This is designated by a value of '0' for the 'capacity' variable. Records for surgical assists and anesthetist billings were excluded ('capacity' variable values of '1', '2', or '3'). A specialty code classifies the physician involved as a general practitioner/family physician (FP) or specific physician specialty (e.g. general internist).

The completeness of the physicians' claims database has not been verified, however given that the information collected is an integral part of the claims for physicians to obtain payment for services, it is considered to be complete in terms of numbers of visits and type of physician visited (Segovia and Edwards, 2001). However, salaried physicians do not submit claims to this database. Therefore in regions where there are larger numbers of salaried physicians, mainly rural areas, these numbers are an underestimate of the provincial health services utilization activity. Access to this database was provided through NLCHI. The following variables were extracted from the MCP physician claims file for each physician contact (both general practitioner (FP) and specialist contacts): MCP number, age and sex of patient, unique provider ID, specialty of provider, date of visit, fee code, diagnosis code, as well as cost and any premium amounts charged. Variables extracted from the MCP databases are described in more detail in Appendix B.

3.4.3 Clinical Database Management System

The CDMS contains demographic, clinical and procedural data on all acute care (in-patient) hospital separations and surgical day-care (SDC) cases and the patients and physicians involved. Only data for acute care hospital separations were used in the current study. The database includes information on residents of Newfoundland and Labrador and out-province residents receiving care in NL health care facilities. Access to this database was provided through NLCHI.

All acute healthcare facilities (hospitals as well as some smaller clinics and nursing stations in rural areas) in Newfoundland and Labrador collect information on acute hospital separations and SDC cases through the Meditech Hospital Information System. These facilities are responsible for submitting subset of data (called a discharge abstract) on each acute care separation and surgical daycare cases to the Canadian Institute for Health Information (CIHI). NLCHI ensures that national and provincial standards for health information are followed by heath records staff within the facilities. The discharge data are stored in the national Discharge Abstract Database (DAD) at CIHI. The data is reviewed for data quality and other specific variables describing characteristics of the hospital separations are determined/calculated (e.g. resource-intensity-weight, case mix groupings, complexity level) and added to the database by CIHI before the annual Newfoundland and Labrador DAD file is provided to the NL Department of Health and Community Services where it is housed as the Clinical Database Management System (CDMS). Subsequently, an annual copy of the data is provided to NLCHI where quality of the information is again verified. The CDMS includes primary (most-responsible) and all other discharge diagnoses, which are coded using either ICD-9 or ICD-10, which are the 9^{th} and 10^{th} revisions of the World Health Organization's International Classification of Diseases and Related Health Problems. These are variable axis classifications with alphanumeric codes. The codes are grouped into chapters, the content of which is based on the etiology of the disease, conditions specific to a certain body system or those related to circumstance. Diagnosis codes are validated annually against hospital charts and have been found to be highly accurate (Newfoundland and Labrador Centre for Health Information, 2004)

Variables extracted from the CDMS included (for each hospital separation): MCP number, hospital separation unique identifier (care-episode ID), date of discharge, main diagnoses, resource intensity weighting, case-mix group, community, and region of residence. Variables are described in more detail in Appendix C.

3.5 Linkage process

3.5.1 Phase I:

All CCHS 1.1 respondents were asked:

1) Whether they wished to share their responses to the survey with other jurisdictions.

2) Whether their survey responses could be linked with provincial health administrative data, and to provide their health insurance number (MCP number in Newfoundland) for this purpose.

Respondents who agreed to share and link their survey responses provided their health insurance numbers (MCP number), which were used to link the health survey sample to the MCP claims file and the Clinical Database Management System to obtain physician and hospital health services utilization. The linkage was completed in two stages:

A) Preliminary linkage to determine percentage of Link-ID file with valid MCP numbers

The CCHS 1.1 Newfoundland and Labrador Share file contained 3730 records and the Link-ID file contained 3497 records. Before linkage of CCHS to administrative health databases could be carried out it was necessary to carry out a preliminary linkage to the MCP registry file in order to determine the proportion of records in the Link-ID file with a valid MCP number (i.e. proportion of CCHS respondents agreeing to link their survey data who provided a valid MCP number). This preliminary linkage was done in two steps:

i) The household ID and person ID variables in both the CCHS 1.1 Share file and CCHS 1.1 Link-ID file were concatenated to form a new composite ID variable called Respondent ID. The Share file was linked to the Link-ID file using this variable as key so that the date-of-birth field in the Share file could be added to the Link-ID file. The Link-ID file (containing MCP number, name and date-of-birth) was linked to the MCP registry file (2003) (containing MCP number of all individuals eligible for health care benefits) via MCP number in order to determine the number of valid MCP numbers in the Link file. A total of 2883 survey respondent records were linked (82% of the Link file and 77% of the Share File). Records which did not link contained missing or invalid MCP numbers.

ii) For the 614 records in the Link-ID file which did not link via MCP number, a second link was performed in order to obtain valid MCP numbers for as many of the remaining survey participants agreeing to link as possible. For this linkage, a composite variable was created in the Link-ID file using the first 4 characters of the first name, the first 4 characters of the last name and the date-of-birth. This was done in both the CCHS Link-ID file and the MCP Registry file. This variable was used to link the remaining records in the Link-ID file to the MCP registry file. A total of 382 additional records were linked using this procedure bringing the proportion of records with valid MCP numbers to 93% of the Link-ID file and 87% of the Share file. Thus, the Link-ID file now contained the original MCP numbers provided plus the additional 382 valid MCP numbers obtained from the MCP Registration file. Thus, the final number of records in the Phase I (CCHS) sample was 3265. (See Figure 4.1 in 'Results' section for a detailed diagram of the preliminary linkage)

B) Linkage of CCHS to administrative health databases

Records in the Newfoundland and Labrador CCHS 1.1 sample were linked to four years (± 2=two years from survey date for each individual) of fee-for-service physician visits (MCP) and acute hospital separation (CDMS) data for 1999-2002 calendar years, via provincial health insurance number (MCP number). See Appendix D for an illustration of the data linkage for Phase I and how the data sources used for the study overlap over time.

3.5.2 Phase II:

For Phase II, in order to obtain a ~10% sample of the provincial population (~50,000) and given that a previous analyses had shown that approximately 35% of a given sample have less than three FP visits in a four-year period, a random sample of 80,000 people were selected. The sample was selected from the subset of the MCP registration containing all patients eligible for health care insurance in the Province and who were alive at the start of the study period (January 1st, 1999). As in Phase I, records for these patients were linked to four years of fee-for-service physician data (MCP) and acute (in-patient) hospital separations data via provincial health insurance number (MCP number). See Appendix E for an illustration of the data linkage for Phase II and how the data sources used for the study overlap over time.

3.6 Measures used in current study

This section describes the variables used for the data analyses. Variables can be described as either independent (explanatory/predictor variables) or dependent (outcome) variables. In simple terms the independent variable can be associated with or predicts the dependent variable. In the current study, continuity of FP care is the main independent variable of interest, whereas the main dependent/outcome variables include those describing health care services utilization which are: number of specialists, contacts, and hospital separations. Two other health care services utilization outcome variables used in the analysis are subsets of these two outcomes variables. The first of these is ambulatory care specialist contacts, which include only specialist contacts made in the physician's office, outpatient department or emergency room. For this variable, billings for such things as radiology and inpatient specialist billings are excluded. The second of these is hospital separations for ambulatory care sensitive conditions (ACSCs). These are hospitalizations for health conditions where appropriate ambulatory care (i.e. primary care) may prevent or reduce the need for hospitalization (Canadian Institute for Health Information, 2008). See Appendix K for a list of these ACSCs and their ICD-9 or ICD-10-CA diagnosis codes. Only hospital separations with a most-responsible diagnosis or one of these conditions are included in this variable. The most-responsible diagnosis is the health condition that can be described as being most responsible for the patient's hospital stay. Secondary diagnosis codes and surgical procedure codes were also extracted from CDMS for determination of this variable. As described in Appendix K, secondary diagnoses were needed to determine diagnosis of some cases chronic obstructive pulmonary disease. Also, hospitalizations with a most responsible diagnosis of heart failure, hypertension or angina that also had an associated cardiac procedure performed were excluded from the 'hospitalization for ACSCs' variable (Appendix K).

Although the purpose of the study is to examine the relationship of the main predictor variable (continuity of FP care) with the above outcomes, there are other variables that can have an impact on the relationship of interest and are referred to as either confounding variables or mediating variables. These variables are correlated both the predictor and the outcome and may distort the true relationship between a predictor and outcome. For example, the relationship between diabetes and hypertension may be confounded by obesity. The difference between a confounder and a mediator is that a mediator is part of the causal pathway between the predictor variable and the outcomes while a confounder is not. When examining a relationship between variables, confounding variables should be controlled for if known (i.e. included in the analyses as co-variates). Therefore, the relationship of interest can be examined with the knowledge that other factors are not clouding the impact.

Another type of variable is called a moderator or effect-modifying variable. If a variable acts as a moderator, the relationship between the predictor and outcome variables changes at different levels of the moderating variable. This is called an interaction effect. In this study it is hypothesized that continuity of FP care will result in reduced health care services utilization and costs that age may act as a moderator of the relationship between continuity of FP care and health services utilization/costs. We hypothesize that continuity of care will be associated with a larger reduction in health care services utilization/costs at older ages.

Selection of the independent, control (co-variate) and dependent (outcome) variables are presented below.

3.7 Calculation/Determination of Variables Used in Analyses.

There were three main types of variables used in the study. These were:

1) Main predictor (independent) variable:

2) Outcome (dependent) variables

3) Co-variates (Control Variables)

3.7.1 Main Predictor Variable (Continuity of FP Care Level)

The main independent variable of interest for the present study is level of continuity of FP care. The specific measure of continuity of care used here is the Continuity of Care Index (COC). This is a well-validated index calculated for each patient from physician claims data and is an index of dispersion of continuity of care which takes into account the frequency and distribution of visits to all family physicians visited by that patient (Bice and Boxerman, 1977; Jee and Cabana, 2006). The COC index was chosen for this project above other measures of continuity as it measures both concentration and dispersion of care, accounts for the number of providers seen and has been shown to have good mathematical performance with a large co-efficient of variation, and has been widely used in many studies, thus permitting comparisons (Reid et al., 2002). Reid et al., 2002 recommended the COC index along with the UPC (usual provider continuity index (UPC) for use by researchers. The COC was chosen over the UPC as it takes into account care patterns by all providers whereas the UPC only takes into account the usual or most-frequently-visited provider.

Only FP visits (specialty code of '001') that occurred in the patient's home or physician's office are included in the calculation of the index. Location of visits is determined from the fee code associated with the visits. Possible values of the COC index range between 0 and 1. A value approaching 0 indicates very low continuity of care where a different provider is seen at each visit (maximum dispersion), while a value of 1 indicates perfect continuity where the same provider is seen at all visits (minimum dispersion) (Christakis et al., 2001b). The formula used for calculation of the COC index values is presented in Appendix F. COC values were calculated using SPSS for Windows version 15.1.0 using the procedure described in Appendix L.

For purposes of the study analyses, the COC index variable was converted to a categorical variable with three possible values: low continuity (COC index score less than 0.5); medium continuity (COC index score greater than or equal to 0.5 and less than 0.75); or high continuity (COC index score greater than or equal to 0.75).

3.7.2. Outcome variables

3.7.2.1 Outcome variables relevant to physician utilization

Utilization outcome variables from the MCP physician claims file used for the study were: total number of physician specialist contacts and number of ambulatory physician specialist contacts. Ambulatory specialists contacts is a subset of total specialists contacts and includes only contacts taking place in the office, out- patients or emergency room (ER). As with FP visits, this is determined from the fee-code associated with the contact. Physician specialists include contacts with a specialty code other than '001', which is for general practitioner (i.e. family physician (FP)). Number of specialist contacts per survey respondent (i.e. per patient) was calculated by summing all specialist contacts for each respondent using the 'aggregate' function in SPSS 15.1.0. The same was done for ambulatory specialist visits. Variables for both total specialist visits and ambulatory specialists visits were both included to allow examination of whether continuity is associated with all specialist contacts (including radiology and in-patient contacts) or just with contacts happening in ambulatory care.

For Phase II of the study the following physician cost outcome variables were included: total FP costs, total specialists costs, and total physician costs, the latter variable being sum of the first two (FP and specialist and costs). Note that although FP costs is used as an outcome, number of FP visits is not. The latter is used as a co-variate in all analyses (see 'Co-variates' section below) to control for physician utilization levels. Number of physician visits per survey respondent (i.e. per patient) was calculated by summing all physician visits for each respondent using the 'aggregate' function in SPSS 15.1.0. This number was separated into the number of FP visits, and the number of specialist visits based on specialty code value. Cost data for each physician visit was extracted directly from the MCP claims file along with data for additional premiums charged. Generally, a physician is only permitted to charge for the main service provided during a visit. In certain circumstances physicians are permitted to charge premium charges over and above normal fees such as for after hour work or call-in for service.

3.7.2.2 Outcome variables relevant to hospital utilization

The main utilization outcome variable drawn from the CDMS was number of acute (inpatient) hospital separations. Phase II also used a second outcome variable which was hospital separations for ambulatory-care-sensitive conditions (ACSCs). The second outcome variable was not used in Phase I because of the small sample size and rarity of the outcome. Phase II also used a hospital cost variable which was estimated using cost-per-weighted case costing methodology used by the Canadian Institute for Health Information (See Appendix G).

3.7.2.2 Outcome variables relevant to mortality

Note that although permission was obtained to use mortality data as an additional outcome it was subsequently decided to omit mortality as an outcome for the study due to the large number of missing health insurance numbers in the mortality files, which would compromise data linkage and the study results.

3.7.3 Co-variates

To guide the selection of co-variates related to the use of health services utilization, Andersen's (1995) model was used (See Appendix H). Andersen's model was chosen because variables mentioned in the model are collected in the CCHS. In addition, although the model was first developed in the 1960's, there have been many modifications made based on subsequent research which suggest that there are a wide array of variables that impact on an individual's use of health services utilization (Andersen, 1995). Some of the variables presented in this model as having an impact on the use of health services that were present in the CCHS and were extracted for the purposes of modeling in the predictive regression analyses described later. A more limited set of variables was extracted for the MCP sample. According to the model health care services utilization is determined by individual need factors (e.g. chronic illnesses), predisposing characteristics (e.g. age and sex), and enabling resources (e.g. socio-economic status and rural vs. urban place residence). For purposes of the current research these variables were used as co-variates as the main relationship of interest was that of continuity of care level with health services utilization and costs.

3.7.3.1 Phase I:

3.7.3.1.1 CCHS:

Co-variates extracted from the CCHS used in analyses are provided in Appendix A and included: demographic variables (age, sex, rural/urban status, income adequacy), lifestyle variables (smoking status, drinking status, consumption of fruits and vegetables, level of physical activity) and health status (self-report of chronic conditions). These variables are classified as co-variates and were included in the analysis to account for the potential effect that they may have on health care service utilization. Extensive literature has demonstrated the impact that these variables have on health care service utilization and other health outcomes (Andersen, 1995).

3.7.3.1.2 MCP Databases:

Number of home and office FP visits was obtained from the physician claims file. Location of FP visits is determined by the fee-code variable. Only home and office visits were included in the analysis, as determined from the fee-codes associated with each visit. Home visits included visit to residents of personal care homes and nursing homes. Number of FP visits per survey respondent (i.e. per patient) was calculated by summing all FP visits for each respondent using the 'aggregate' function in SPSS 15.1.0.

3.7.3.2 Phase II:

While the sample for Phase II was much larger than that used in Phase I, there were fewer co-variates available to incorporate into analyses. Gender of the patient was extracted from the MCP registration file. The age variable used in the study was the age in years at the start of the study period, January 1st, 1999. Age was calculated by subtracting this date from the date of birth for each patient in the MCP registration file. Rural/urban status was determined by using the Postal Code Conversion file (PCCF+) provided by Statistics Canada to covert the postal code of residence of the patient to community and obtaining the population of the community from the 2001 Statistics Canada Census data. A population of less than 5000 was considered rural while a population of 5000 or more was considered urban.

For each patient an ICD-9 diagnosis code associated with each FP contact or specialist contact was obtained from the physician claims file and the most-responsible diagnosis code for each hospital separation was obtained from the CDMS (ICD-9 code prior to April 2001; ICD-10 code thereafter). SPSS was used to determine presence or absence of ICD diagnosis codes for a list of serious health conditions (Appendix I) for each patient in the Phase II study sample. Both physician and hospital diagnosis codes were used. A variable was calculated called the "chronic conditions" variable which was a count of the number of diagnosed health conditions in the list for each patient in the Phase II study sample. This variable served as a control variable for health status (i.e. co-variate). Health conditions used for this variable were matched as closely as possible to serious chronic conditions asked about in the CCHS using appropriate ICD diagnosis codes. However, we omitted conditions for which it was difficult to obtain diagnosis codes (e.g. back pain and allergies). Note that not all health conditions included in the list were actually chronic illnesses (e.g. acute myocardial infarction).

Finally, an aggregate measure of socio-economic status (SES), in the form of a quintile rank, was derived from 2001 Statistics Canada Census data similar to that used by Menec et al. (2005) in a study of continuity of care in the province of Manitoba. Statistics Canada dissemination areas (DAs) within Newfoundland and Labrador were ranked from poorest to wealthiest based on mean household income, and then grouped into five population quintiles such that each quintile contained approximately 20% of the reported population for ages 15 and over for included DAs. The postal code conversion file (PCCF+) provided by Statistics Canada was used to map the postal code of the subject from the MCP registration file to a DA and thus obtain a quintile rank (between 1 and 5) for that subject. By using the 'single link' field in the PCCF+ in excess of 99% of postal codes mapped to a single most-appropriate DA. In the few cases where the same postal code mapped to multiple DAs, the postal code was mapped to DA with the highest population, ages 15 and over.

3.8 Study Procedure

3.8.1 Phase I:

SPSS version 15.1.0 for Windows was used to link records in the Newfoundland and Labrador sample of the CCHS 1.1 (2000/01) sample to physician (MCP claims file) and hospital and (CDMS) data via MCP number. Data sources were examined to determine proportion of survey participants with family physician/specialist contacts and hospitalizations over a four-year period (two years pre- and two years post-CCHS survey-date for each survey participant) (See Appendix D). For each survey participant having 3 or more FP visits during the four-year study period, COC index of FP continuity of care scores was calculated over a four-year period (+/- 2 years from survey date) using the MCP claims data obtained in the above linkage. The sample was divided into three groups of varying levels of continuity based on COC index score ranges as in Table 3.2 below.

Table 3.2: COC Ranges for Continuity Groups

Continuity Group	COC Index Value Range
Low Continuity	< 0.5
Medium Continuity	≥ 0.5 and < 0.75
High Continuity	≥ 0.75

Patients with place of residence in the Labrador and Grenfell regions (as indicated in the CCHS) were excluded from analyses because of much lower numbers of physician visits per person in the MCP claims database than in the other four health boards (St. John's, Eastern, Central and Western) as seen in Table 3.1. These two regions have very small numbers of fee-for-service physicians (Department of Health and Community Services, Government of NL, 2000). Specific analyses performed are detailed in the next section.

3.8.2 Phase II:

Phase II consisted of two separate analyses. A cross-sectional analysis similar to that conducted in Phase I, in which both continuity and outcomes were measured over a 4-year period (calendar years 1999-2002), and a longitudinal analysis where continuity was measured for a two-year period (calendar years 1999-2000) and outcomes were measured in the two-year period immediately following (calendar years 2001-2002).

SPSS 15.1.0 for Windows was used to select a random sample of 80,000 people from people in the MCP registration file (2003) who were alive at the start of the study period (January 1st, 1999). The sample was linked, as in Phase I, to physician visits (MCP) and acute care hospital separation (CDMS) data via MCP number. This sample was used for both the cross-sectional and longitudinal analyses. Patients having less than 3 FP visits during the period for which continuity was measured (four-year period for the cross-sectional analysis and two-year period for the longitudinal analysis) were excluded from analyses. As can be seen in the 'Results' section, more patients were excluded from the longitudinal analysis than from the cross-sectional analysis because fewer patients met the inclusion criterion of at least three FP visits in the two-year period (1999-2000) than in the four-year period (1999-2002).

COC index of FP (general practitioner) continuity of care scores were calculated over the four or two-year study period (1999-2002) using the MCP claims data obtained in the above linkage. The sample was divided into three continuity of care levels based on COC index value, as in Phase I. Data analyses performed are described in the next section.

3.9 Data Analysis

3.9.1 Phase I:

i) Descriptive statistics (i.e. cross-tabulations) for HSU outcomes and co-variates were calculated by continuity of care level (Low, Medium and High). Bivariate comparisons were used to examine differences in outcomes and covariates among continuity groups (low, medium and high). A one-way ANOVA was used for age, chi-squared for categorical variables and Kruskal-Wallis test for HSU outcomes, which were discrete variables with highly-skewed distributions. HSU outcomes and co-variates are listed below.

- HSU Outcomes
  - Specialist visits
  - Ambulatory specialist visits
  - Acute (inpatient) hospital separations
- Co-variates
  - Demographics (Age, gender, marital status, rural/urban)

- Health Status (Number of chronic conditions)
- Lifestyle (Smoking status, Drinking status, Physical activity level)
- Income adequacy
- Utilization characteristics (Number of FP visits)

Analyses were performed using SPSS 15.0.1 for Windows.

ii) Backward conditional log-linear regression analyses were used to assess the relationship of continuity of FP care (using 'high continuity' as the reference category) with health care service utilization outcome variables while adjusting for co-variates. Analyses were performed using the statistical software package R, version 2.6.0.

As described above co-variate variables were chosen for the analysis based on Andersen's model and entered into the backward conditional regression which removed variables, one by one until the optimal combination of variables in the model which best predicted the outcomes was reached.

HSU data involving discrete counts are often modeled using a Poisson distribution, which assumes equal variance and mean. However, in many cases these data exhibit overdispersion, where variance is larger than the mean. If not accounted for, this may result in an underestimation of standard errors, narrower confidence intervals, and smaller p-values. The negative binomial model has a built-in dispersion parameter that can account for this excessive variability. To test for overdispersion, a likelihood ratio test was constructed to compare Poisson and negative binomial models. This statistic tests whether a calculated value known as an over-dispersion parameter equals zero as indicated by a p-value. Where overdispersion was present, the negative binomial regression model was used instead of Poisson.

iii) Given that one way to examine an interaction is to examine the relationship between two variables (continuity and a measure of health care services utilization) at different levels of a third variable (age), separate analyses similar to (i) and (ii) above were performed by different age groups in order to examine the effect of age on the relationship between continuity of FP care and health care services utilization (each including descriptive statistics, bivariate comparisons and regression analysis). Age groups used were age 12+ (whole sample), 55+ and 65+.

Weighting of CCHS Data

In order to obtain unbiased point estimates, all analyses using CCHS data were weighted using normalized sampling weights, due to the non-random sampling design of the survey, as done in a previous study (Sanmartin et al, 2007). Statistics Canada uses a complex multi-stage design, with over-sampling for some sub-populations (i.e. health boards). Consequently, sampling weights have been developed to account for survey design and to provide an adjustment for survey non-response. To account for sampling design the CCHS contains a 'weight variable' that represents the number of individuals that the survey respondent represents. Statistics Canada suggests that all analyses should be run using the weight 'turned on'. Weights were normalized by computing the average of the sample weights for study participants and dividing each participant's weight value by the mean weight value. The sum of the normalized weights approximately equals the sample number rather than the population of Newfoundland and Labrador, which would be the sum of the sample weights. This allows for a more representative sample and, at the same time, avoids using a larger N (equal to the population sample size) obtained when using the regular sampling weights that may lead to a large unrealistic number of statistically-significant results.

3.9.2 Phase II:

The cross-sectional and longitudinal analyses each involved the following sub-analyses:

i) Descriptive statistics (i.e. cross-tabulations) for health care services utilization outcomes and co-variates were calculated by continuity of care level (Low, Medium and High). Bivariate comparisons were used to examine differences in outcomes and covariates among continuity groups (low, medium and high). A one-way ANOVA was used for age, chi-squared for categorical variables, and Kruskal-Wallis test for HSU outcomes, which were discrete variables with highly-skewed distributions. Health care service utilization outcomes and co-variates are listed below.

- HSU Outcomes
  - Specialist visits

- Ambulatory specialist visits
- Acute (inpatient) hospital separations
- Acute (inpatient) hospital separations for ACSCs

- Co-variates
  - Demographics (Age, gender, rural/urban)
  - SES (Income quintile)
  - Utilization characteristics (Number of FP visits)

Analyses were performed using SPSS 15.0.1 for Windows.

ii) Similar to Phase I, Backward conditional log-linear regression analyses were used to assess the relationship of continuity of FP care (using 'high continuity' as the reference category) with health care service utilization outcome variables while adjusting for co-variates. Analyses were performed using the statistical software package R, version 2.6.0. As in Phase I, either the Poisson or Negative binomial models were used depending on whether overdispersion was found to be present.

iii) Descriptive statistics and bi-variate comparisons similar to i) above were performed to examine differences in health care cost outcomes between continuity groups. Costs variables were also skewed. Health care cost outcome variables are listed below:

- Health Care Cost Outcomes

- FP Cost
- Specialist Cost
- Total Physician Cost
- Hospital Cost

iv) Tobit multiple regression analysis was used to determine if level of continuity of FP care was a predictor of health care cost outcomes, again controlling for the same co-variates as in ii) above, using the statistical software package R, version 2.6.0. Due to the non-normal distribution of the cost data, data were transformed using the natural log function (ln) to produce data with a normal distribution. Because of '0' (zero) values present in the health care cost outcome data (i.e. people without hospitalizations/specialists visits) a small constant value was added to the HSU variables before log-transformations were performed given that ln(0) is undefined. The distributions in the HSU cost variables produced by log-transformation were normal except for a large spike at the left corresponding to patients with a zero value for that variable. The tobit model was set to censor these cases with zero cost. Note that for FP visits and total physician cost it was not possible to have zero cost values due to the study inclusion criterion that patients must have at least 3 FP visits. Thus, for these outcomes the regressions were effectively OLS regressions. In the hospital cost analysis it was found that the tobit model resulted in very wide confidence intervals probably due to the censoring of zero cases, which for hospitalization data, comprised about 70% of cases (only about 30 % of patients were hospitalized). This reduced the sample size dramatically. Thus, it was decided to use ordinary least squares (OLS) regression for the hospital cost analysis. Given that when the zero cost cases were included in the analysis the normality assumption of OLS regression was violated, zero-cost cases were excluded from the OLS regression analysis of hospital data.

v) Separate analyses similar to (i), (ii), (iii), and (iv) above were performed by age group in order to examine the effect of age on the relationship of continuity of FP care and with health care services utilization and cost outcomes (each including descriptive statistics, bivariate comparisons and appropriate regression analysis). In Phase II, two sets of age group were used. The first set was ages 12+ (whole sample), 55+, 65+ and 75+. The second set was ages 12-19, 20-44, 45-64, 65-74 and 75+.

3.10 Ethical considerations

The study was approved by the Human Investigation Committee, Memorial University, of Newfoundland (see Appendix J). Permission to use each of the data sources used in the study was obtained from the appropriate data custodian responsible for the data source. Letters of permission from each data custodian are included in Appendix J. Permission to use the Canadian Community Health Survey 1.1 Share and Link-ID files was received from the Provincial Department of Health and Community Services; permission to use the MCP databases was obtained from MCP within the provincial Department of Health and Community Service; permission to the Provincial Mortality Surveillance System (MSS) was obtained from the Vital Statistics Division of the Provincial Department of Government Services (although this outcome was omitted from the final analysis); and permission to use the Clinical Database Management System (CDMS) was received from the NLCHI. All data custodians agreed that staff at the Newfoundland and Labrador Centre for Health Information would perform the data linkage and remove all personal identifiers (name, address, telephone and health insurance number from the research data set after linkages were conducted, which was the case. This is specified in the permission letter from the Director of Research and Evaluation, NLCHI. An anonymous unique identifier ID number replaced the MCP number. NLCHI required that a Privacy Impact Assessment and confidentiality agreement for data use be completed (Appendix J.) Access to the identities associated with the personal health information was limited to NLCHI staff. Linked study research databases were burned to CD, which, along with all paper forms and printouts of study data, were kept in a locked filing cabinet in an office. Computer files related to the study were password-protected and kept on a password-protected computer non-networked computer in different office, which was locked when vacated. Both offices were in a secure building.

CHAPTER 4: RESULTS

The purpose of the chapter is to present the findings of the current research study examining the relationship of continuity of family physician care with health care services utilization outcomes and costs using two different samples: the Newfoundland sample of the Canadian Community Health Survey (CCHS) (Phase I) and the MCP registry sample (Phase II). The study results are presented in five main sections. **Section 4.1** presents the results of Phase I, which uses a sample consisting of the Newfoundland and Labrador sample of the Canadian Community Health Survey (CCHS) version 1.1 (2000/01). Both continuity and health services utilization outcomes are measured over a four-year period extending from two years before to two years after CCHS survey date for each participant. **Section 4.2** presents the results of the first analysis of Phase II (Cross-sectional analysis) involving a sample from the MCP registry file where both continuity and health services utilization outcomes are measured over the same four-year period (calendar years 1999-2002). **Section 4.3** presents the results of the second analysis of Phase II (Longitudinal analysis) involving the same sample as in Section 4.3. Here, in order to more accurately determine whether continuity is driving any change in health care services utilization, continuity is measured over a two-year period (1999-2000) and health services utilization/cost outcomes are measured over the two-year period immediately following (2001-2002). **Section 4.4** presents the results of the cost analyses for the two MCP Registry analyses in Phase II. Finally, **Section 4.5** presents a summary of the results.

4.1 Analysis of Newfoundland sample of the Canadian Community Health Survey

4.1.1 Sample and Exclusions

Figure 4.1 presents the results of the procedure by which the final study sample (Phase I) was obtained including the results of the preliminary linkage of CCHS and subsequent exclusions of study participants. The Newfoundland and Labrador CCHS 1.1 Share file used for the sample consisted of 3730 individuals ages 12 and over. Of these, 3497 survey participants agreed to link their survey data to other data sources and were thus included in the CCHS 1.1 Link-ID file, which included health insurance numbers of participants and other personal information. The 233 participants not agreeing to link were excluded from the sample. To determine the validity of health insurance numbers (MCP number in Newfoundland and Labrador) provided by survey participants a preliminary linkage was carried out. Records in the Link-ID file were linked to the MCP registry file (for 2003) by MCP number. Of these records, 2883 were successfully linked to the registry file. The remaining records had either missing or invalid MCP numbers. This amounted to 77% of records in the Share file and 82% of records in the Link-ID file. The 614 remaining records in the Link-ID file were linked again to the MCP registry file, this time by a combination of first and last name and date of birth. In this linkage an additional 382 records were linked bringing the CCHS study sample to 3265 successfully-linked records (87.5% of the Share File). For this sample, the average number of family physician (FP) home and office visits per patient was determined for survey participants in each Health and Community Services region used in the CCHS 1.1 in order to compare fee-for-service physician activity among regions.

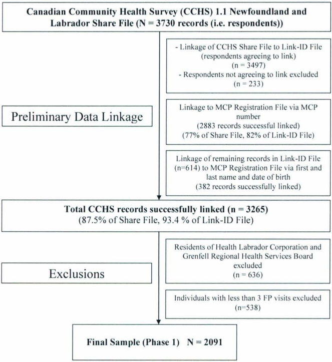

Figure 4.1 Sample Selection - Phase I (Preliminary Linkage)

Table 4.1: Number of Home and Office Family Physician Visits by Former Health and Community Services Region

Region	Number of FP Visits per Patient [Mean (Std. Dev.)]
St. John's	19.6 (15.3)
Eastern	19.2 (17.9)
Central	16.3 (13.0)
Western	18.9 (32.0)
Grenfell	9.5 (7.0)
Labrador	12.2 (11.2)

Table 4.1 shows the mean number of FP visits per patient. One can see that the Labrador and Grenfell regions have a much lower number of FP visits per patient than the other four Health and Community Services regions, most likely indicating that many people in these regions are seeing salaried FPs for whom visits to are not tracked in the MCP claims system. The low numbers in the former Grenfell and Labrador regions in the table are consistent with Table 3.1 from the Methodology section, which shows the Labrador and Grenfell regions together as having the smallest proportion of fee-for-service FPs. In addition, nurse practitioners substitute for FPs more in these two regions. For these reasons, participants from the Labrador and Grenfell region were excluded from the analysis. Continuing with Figure 4.1, 636 CCHS survey participants who were residents of the Labrador and Grenfell regions were excluded from the sample. Finally,

the 538 survey participants with less than three FP visits during the study period were also excluded from the sample. This left a final CCHS sample of 2091, which was used for the analysis in Phase I of the study.

4.1.2 Descriptive Statistics

4.1.2.1 Main Predictor Variable and Co-variates

Note that in the descriptive statistics for the Phase I sample (CCHS sample) (N=2091) totals for covariates may not total to 2091 due to survey sample weighting and/or missing data. Table 4.2 presents socio-demographic variables by continuity of care level. For the 2091 individuals in the study sample the mean age was 43.4 (standard deviation 18.20) and 56.6 % were female. The overall average COC index value was 0.724. Almost 55 % of the sample fell into the high continuity group with a COC value of 0.75 or higher, 20 % fell into the medium continuity group and 25% into the low continuity group. Statistically significant differences existed between continuity of care groups (low, medium, or high) with relation to gender, mean age, 15-year age category, marital status, income adequacy, and rural/urban status. Differences between continuity groups relating to income were not statistically significant. In moving from the low to the high continuity group, survey participants were more likely to be male, older, have a partnered marital status, and lower income. There was a trend towards the medium continuity group being more likely to be from an urban area than either the low or high continuity groups.

Table 4.3 presents lifestyle characteristics by continuity of care level. There were

Table 4.2: Socio-demographics by Continuity of Care Level (Ages 12+) (N=2091)

Characteristic	Low Continuity COC < 0.5	Medium Continuity $0.5 \leq COC < 0.75$	High Continuity $COC \geq 0.75$	Total[1]	p-value
		[Count (%)]			
n (% of Sample)	529 (25.3)	410 (20.0)	1143 (54.7)	2091 (100)	--
Gender					
Male	199 (37.5)	181 (41.6)	528 (46.9)	908 (43.4)	0.001*
Female	331 (62.5)	254 (58.4)	599 (53.1)	1184 (56.6)	
Age (years)					
Mean (SD)	37.2 (17.04)	41.2 (18.71)	47.4 (18.71)	43.4 (18.20)	<0.001*
Age Groups					
12-19	97 (18.3)	55 (12.7)	91 (8.1)	243 (11.6)	<0.001*
20-44	261 (49.2)	194 (44.7)	418 (37.1)	873 (41.8)	
45-64	131 (24.7)	126 (29.0)	399 (35.4)	656 (31.4)	
65-74	27 (5.1)	38 (8.8)	140 (12.4)	205 (9.8)	
75+	14 (2.6)	21 (4.8)	78 (6.9)	113 (5.4)	
Marital Status					
Partnered	307 (58.0)	269 (61.8)	747 (66.5)	1323 (63.4)	0.003*
Un-partnered	222 (42.0)	166 (38.2)	377 (33.5)	765 (36.6)	
Income Adequacy					
Lower two income quartiles	223 (45.1)	202 (50.0)	562 (52.5)	987 (50.1)	0.024*
Upper two income quartiles	272 (54.9)	202 (50.0)	509 (47.5)	983 (49.9)	
Rural/Urban					
Urban	359 (67.7)	320 (73.6)	759 (67.3)	1438 (68.7)	0.050*
Rural	171 (32.3)	115 (26.4)	368 (32.7)	654 (31.3)	

* indicates $p < 0.05$ [1] Totals may not sum to 2091 due to sample weighting and/or missing data

Table 4.3: Life-Style Characteristics by Continuity of Care Level (Ages 12+) (N=2091)

Characteristic	Low Continuity COC < 0.5 (N=529)	Medium Continuity 0.5 ≤ COC < 0.75 (N=419)	High Continuity COC ≥ 0.75 (N=1143)	Total[1] (N=2091)	p-value
	[Count (%)]				
Smoking					
Daily/Occasionally	140 (26.5)	103 (23.7)	322 (28.6)	565 (27.0)	0.141
Not at all	389 (73.5)	332 (76.3)	805 (71.4)	1526 (73.0)	
Drinking					
Regular Drinker	270 (51.0)	209 (48.0)	530 (47.0)	1009 (48.3)	0.312
Occasional/Former Drinker/Never Drank	259 (49.0)	226 (52.0)	597 (53.0)	1082 (51.7)	
Physical Activity					
Active/Moderately Active	201 (40.1)	169 (39.7)	400 (36.6)	770 (38.1)	0.300
Inactive	300 (59.9)	257 (60.3)	694 (63.4)	1251 (61.9)	
Fruit and Vegetable Consumption					
Less than 5 daily Servings	360 (68.6)	294 (67.6)	799 (71.2)	1453 (69.8)	0.294
5 or more daily Servings	165 (31.4)	141 (32.4)	323 (28.8)	629 (30.2)	

[1] Totals may not sum to 2091 due to sample weighting and/or missing data

no statistically significant differences between continuity of care groups for any of the lifestyle measures. Table 4.4 presents health status co-variates by continuity of care level. There were statistically significant differences between continuity of care groups relating to mean number of chronic conditions, chronic-conditions category, mean number of FP visits and FP-visit category. Number of chronic conditions and FP visits increased with increasing continuity.

Table 4.4: Health Status Characteristics by Continuity of Care Level (Ages 12+) (N=2091)

Characteristic	Low Continuity COC < 0.5 (N=529)	Medium Continuity 0.5 ≤ COC < 0.75 (N=419)	High Continuity COC ≥ 0.75 (N=1143)	Total[1] (N=2091)	p-value
	[Count (%)]				
Number of Chronic Conditions					
Mean (SD)	1.17 (1.40)	1.39 (1.44)	1.53 (1.60)	1.41 (1.53)	<0.001*
0	205 (38.8)	145 (33.3)	366 (32.5)	716 (34.2)	<0.001*
1	164 (31.0)	127 (29.2)	281 (24.9)	572 (27.4)	
2+	160 (30.2)	163 (37.5)	480 (42.6)	803 (38.4)	
FP Visits (Home and office only)					
Number of FP Visits (Mean (SD))	16.36 (21.86)	18.08 (14.33)	18.96 (16.38)	18.12 (17.58)	<0.001*
3-10	238 (44.9)	147 (33.9)	418 (37.1)	803 (38.4)	0.001*
11-20	147 (27.7)	144 (33.2)	314 (27.9)	605 (28.9)	
21+	145 (27.4)	143 (32.9)	394 (35.0)	682 (32.6)	

* indicates p < 0.05 [1] Totals may not sum to 2091 due to sample weighting and/or missing data

Given that one of the major objectives of the study was to examine the effects of age on the relationship between continuity of care and outcomes, descriptive statistics were also run for 55+ and 65+ age groups and tables are included Appendix M (Tables M1-M6). From the tables we can see that there were fewer significant differences in co-variates between continuity groups for the 55+ and 65+ age groups. For the 55+ age group significant differences between continuity groups were found only the FP-visits category, while for the 65+ age group significant differences were found only for drinking status.

4.1.2.2 Health Care Services Utilization Outcomes

Table 4.5 presents descriptive statistics for per-patient health care utilization measures for the overall study sample. Patients had a total of 37,881 home and office fee-for-service FP visits over the four-year study period for a mean of 18.12 FP visits per patient over four years; 91.4 % of the sample had a least one specialist contact during the study period while 69.9 % of the sample had at least one ambulatory specialist contact. Patients had a total of 24,337 specialist contacts, 9838 of which were ambulatory contacts yielding means of 11.64 per person for total specialist contacts and 4.71 for ambulatory specialist contacts over four years. Over a quarter (26.5 %) of the sample had at least one acute (inpatient) hospitalization with patients being hospitalized 994 times for a mean of 0.48 hospitalizations per person over four years. All four utilization measures were positively-skewed with FP and specialists visit being more variable and more positively skewed than ambulatory specialist visits or hospitalizations.

Table 4.6 presents specialist utilization outcomes by continuity of care level for the following age groups: 12+ (all ages), 55+ and 65+. For total specialist contacts significant differences existed between continuity of care groups for all three study samples. For the 12+ and 55+ age groupings, the medium continuity of care group tended to have the highest number of specialist contacts while for the 65+ age group the low continuity group tended to have the highest. For ambulatory specialist contacts specifically, there were significant differences between continuity groups for the 55+ and 65+ age groups with the low continuity group tending to have the highest number of ambulatory specialist contacts. There were no significant differences seen for the 12+

Table 4.5: Descriptive Statistics for Per-Person Health Care Services Utilization for 4-year Period (+/- 2 Years from Survey Date), CCHS (N=2091)

Measure	Mean (SD) (per Person)	Median	Minimum	Maximum
Total FP Visits (H&O)	18.12 (17.58)	14	3	589
Total Specialists Contacts	11.64 (17.26)	6	0	339
Ambulatory Specialist Contacts	4.71 (7.52)	2	0	78
Inpatient Hospital Separations	0.48 (1.07)	0	0	12

Table 4.6: Specialist Utilization by Continuity Group by Age Group (CCHS Sample) Continuity and Outcomes over same 4-year period (1999-2002)

Type of Physician	Age Group (Yrs)	Continuity of Care Level				p-value
		Low (<0.5)	Medium (0.5-0.74)	High (≥0.75)	Overall	
		Mean (SD	Mean (SD)	Mean (SD)	Mean (SD)	
Total Specialist Contacts[1]	12+	10.93 (19.29)	12.23 (16.39)	11.74 (16.57)	11.64 (17.26)	0.006*
	55+	23.25 (29.50)	28.90 (19.24)	17.49 (20.54)	18.94 (21.94)	0.007*
	65+	29.95 (36.57)	24.24 (20.17)	20.76 (24.17)	22.58 (25.54)	0.003*
Ambulatory Specialist Contacts[1]	12+	4.58 (7.68)	4.95 (7.59)	4.67 (7.42)	4.71 (7.52)	0.225
	55+	9.22 (13.19)	8.14 (9.12)	6.18 (7.83)	6.98 (9.10)	0.010*
	65+	9.94 (10.30)	8.22 (8.68)	7.19 (8.97)	7.73 (9.12)	0.048*

[1]Number of contacts per person over 4-year period * indicates $p < 0.05$

age group.

Table 4.7 presents hospital utilization outcomes by continuity of care level for the same age groups used for the previous specialist data. There were no significant differences between continuity of care groups although differences for the 65+ age group approached significance with a trend towards the low continuity group having the highest number of hospitalizations.

Table 4.7: Inpatient Hospital Utilization by Continuity Group by Age Group (CCHS Sample) Continuity and Outcomes over same 4-year period (1999-2002)

	Age Group (Years)	Continuity of Care Level: Low (<0.5) Mean (SD)	Medium (0.5-0.74) Mean (SD)	High (≥0.7) Mean (SD)	Overall Mean (SD)	p-value
Total Hospital Separations[1]	**12+**	0.44 (1.02)	0.56 (1.26)	0.46 (1.01)	0.48 (1.07)	0.116
	55+	1.00 (1.73)	0.91 (1.77)	0.72 (1.30)	0.80 (1.47)	0.243
	65+	1.65 (2.21)	1.40 (2.20)	0.99 (1.49)	1.15 (1.76)	0.079

[1]Number of hospital separations per person over 4-year period

4.1.3 Multivariate Analysis

Health care utilization data involving discrete counts are often modeled using a Poisson distribution, which assumes equal variance and mean. However, in many cases these data exhibit overdispersion, where variance is larger than the mean. If not accounted for, this may result in an underestimation of standard errors, narrower confidence intervals, and smaller P-values (Agresti, 2002). The negative binomial model has a built-in dispersion parameter that can account for this excessive variability. To test for overdispersion, a likelihood ratio test was constructed to compare Poisson and negative binomial models. Where overdispersion was present, the negative binomial regression model was used instead of Poisson. Backward conditional regression analysis was used to investigate the relationship of continuity of care and co-variates with each of the HSU outcomes for all ages in the sample (i.e. the 12+ age group). Results are presented in terms of rate ratios, which are equal to the anti-log of the regression co-efficient.

Table 4.8 presents model fit characteristics for the final step of a backward conditional regression for each of the three HSU outcomes (hospital separations, specialist contacts, and ambulatory specialist contacts). Means and variances differ slightly from those in Table 4.5 due cases omitted due to missing data in the regression

Table 4.8: Model Fit Characteristics for Health Care Services Outcomes

Measure	Variance	Mean	Overdispersion Parameter (Variance/mean)	Likelihood Test (p-value)
Total Specialists Contacts	301.9	11.5	26.2	<0.001*
Ambulatory Specialist Contacts	50.5	4.5	11.3	<0.001*
Inpatient Hospital Separations	1.13	0.48	2.36	<0.001*

* indicates $p < 0.05$

Note: Means and variances differ from those in Table 4.5 because of excluded cases due to missing data analyses. Likelihood ratio tests for overdispersion indicated that overdispersion was present ($p<0.001$) for all three HSU measures although overdispersion was much less for hospital separations than the two specialist contacts measures as indicated by a much smaller dispersion parameter. Thus, the Poisson model was used for the regression models involving hospital separations and the negative binomial model for the regression models involving the two specialist measures.

Table 4.9 presents the results of the final step of a backward condition regression involving factors associated with number of hospital separations for the whole CCHS sample (ages 12+). Low continuity of care was associated with a 25.0% increase in hospital separations relative to high continuity while medium continuity was associated with a 55.3 % increase in hospital separations. Other factors associated with number of hospitalizations included age, rural/urban status, physical activity level, number of FP visits and number of chronic illnesses.

Table 4.10 presents the results of the final step of a backward conditional regression involving factors associated with number of specialist contacts. Medium continuity of care was associated with a 22.6% increase in specialist contacts relative to high continuity while there was no significant increase for low continuity. Other factors associated with number of specialist contacts were age, gender, number of FP visits, and number of chronic illnesses.

Table 4.11 presents the results of the final step of a backward condition regression involving factors associated with number of ambulatory specialist contacts. Low continuity of care was associated with a 18.8% increase in ambulatory specialist contacts

Table 4.9: Factors Associated with Inpatient Hospitalizations (Poisson Regression) (Age 12+) (N=2091)

Characteristic	Adjusted Analysis Rate Ratio (95 % C.I.)
Continuity of FP Care	
High (> 0.75)	**1.00**
Medium (>0.5 but < 0.75)	1.553* (1.324-1.821)
Low (< 0.5)	1.250* (1.054-1.483)
Age	1.010* (1.006-1.014)
Urban/Rural	
Rural	**1.00**
Urban	0.673* (0.588-0.771)
Physical Activity	
Active	**1.00**
Inactive	1.504* (1.286-1.760)
Total FP Visits	
High (21+)	**1.00**
Medium (11-20)	0.508* (0.482-0.603)
Low (3-10)	0.350* (0.288-0.425)
Number of Chronic Conditions	
0	**1.00**
1	0.894 (0.724-1.105)
2+	1.408* (1.166-1.699)
Income Adequacy	
Lower two income quartiles	**1.00**
Upper two income quartiles	0.834* (0.722- 0.963)

Table 4.10: Factors Associated with Total Specialist Contacts (Negative Binomial Regression) (Age 12+) (N=2091)

Characteristic	Adjusted Analysis Rate Ratio (95 % C.I.)
Continuity of FP Care	
High (> 0.75)	**1.00**
Medium (>0.5 but < 0.75)	1.226* (1.093-1.375)
Low (< 0.5)	1.115 (0.999-1.243)
Age	1.017* (1.014-1.020)
Gender	
Female	1.161* (1.057-1.276)
Total FP Visits	
High (21+)	**1.00**
Medium (11-20)	0.647* (0.577-0.725)
Low (3-10)	0.381* (0.339-0.429)
Number of Chronic Conditions	
0	**1.00**
1	0.947 (0.844-1.064)
2+	1.467* (1.306-1.647)

Table 4.11: Factors Associated with Ambulatory Specialists Contacts (Negative Binomial Regression) (Age 12+) (N=2091)

Characteristic	Adjusted Analysis Rate Ratio (95 % C.I.)
Continuity of FP Care	
High (> 0.75)	**1.00**
Medium (>0.5 but < 0.75)	1.285* (1.075-1.535)
Low (< 0.5)	1.188* (1.005-1.404)
Age	1.015* (1.011-1.019)
Total FP Visits	
High (21+)	**1.00**
Medium (11-20)	0.699* (0.587-0.832)
Low (3-10)	0.332* (0.277-0.396)
Number of Chronic Conditions	
0	**1.00**
1	1.033 (0.863-1.235)
2+	1.540* (1.290-1.838)
Income Adequacy	
Lower two income quartiles	**1.00**
Upper two income quartiles	1.352 (1.177-1.554)

relative to high continuity while medium continuity with a 28.5 % increase in number of ambulatory specialist contacts relative to high continuity. Other factors associated with number of ambulatory specialist contacts included age, number of FP visits and number of chronic illnesses.

Tables for similar regression analyses for age groups 55+ and 65+ are presented in Appendix N.

Table 4.12 presents a summary of the rate ratios for the continuity of care variable in the regression analysis for each health services utilization outcome by age group.

Table 4.12 Summary of Log-Linear Regressions - CCHS Sample

Table 4.12A: Continuity and Inpatient Hospital Separations (1999-2002)

Continuity Group	Rate Ratios			
	Age Group (Years)			
	12+	55+	65+	75+
High	**1.00**	**1.00**		---
Medium	1.553* (1.324-1.821)	1.503* (1.172-1.928)	1.763* (1.277-2.432)	---
Low	1.250* (1.054-1.483)	1.608* (1.222-2.115)	1.873* (1.408-2.491)	---

* indicates significant differences from reference group

Table 4.12B: Continuity and Specialist Contacts (1999-2002)

Continuity Group	Rate Ratios			
	Age Group (Years)			
	12+	55+	65+	75+
High	**1.00**	**1.00**		---
Medium	1.226* (1.093-1.375)	1.275* (1.052-1.547)	1.456* (1.116-1.898)	---
Low	1.115 (0.999-1.243)	1.368* (1.105-1.693)	1.652* (1.218-2.240)	---

* indicates significant differences from reference group

Table 4.12C: Continuity and Ambulatory Specialist Contacts (1999-2002)

Continuity Group	Rate Ratios			
	Age Group (Years)			
	12+	55+	65+	75+
High	**1.00**	**1.00**		---
Medium	1.285 (1.057-1.535)	1.388* (1.075-1.792)	1.266 (0.930-1.722)	---
Low	1.188* (1.005-1.403)	1.513* (1.136-2.007)	1.871* (1.303-2.688)	---

* indicates significant differences from reference group

Table 4.12A presents rate ratios for continuity and hospital separations. As indicated previously, in the overall sample (i.e. ages 12+) being in the medium continuity group was associated with a 55.3% increase in hospital separations relative to the high continuity group while the low continuity group was associated with only a 25.0% increase in hospitalization. One would have expected the low continuity group to be associated with more of an increase in hospital separations than the medium continuity group. Indeed as we move to the 55+ and 65+ age groups, we see a shift towards the expected pattern. This shift coincides with the loss of significant differences in co-variates between continuity groups described previously. For example, in the 12+ analysis the low continuity group had lower age and lower numbers of chronic conditions and FP visits.

Rate ratios for total and ambulatory specialists contacts showed a similar pattern to that of hospital separations over the three age groups, with the exception that the associations for the medium continuity group for ambulatory specialist visits were not statistically significant for the 12 + or 65+ age groups (Tables 4.12B and 4.12C).

4.2 Cross-sectional Analysis of Sample from the MCP Registry File (Continuity and HSU Outcomes measured over the same 4-year period)

4.2.1. Sample and Exclusions

Figure 4.2 presents results of the procedure by which the final study sample for the cross-sectional MCP analysis of Phase II was obtained including exclusions of study participants. A sample of 80,000 individuals was selected from the MCP registration file and 5733 individuals who were residents of the Labrador and Grenfell regions were excluded from the sample. Finally, the 23,768 patients with less than three FP visits during the study period were excluded from the sample. This left a final MCP sample of 50,499 individuals, which was used for the first (cross-sectional) analysis in Phase II of the study.

4.2.2 Descriptive Statistics

4.2.2.1 Main Predictor Variable and Co-variates

Table 4.13 presents socio-demographic and health status variables for the MCP cross-sectional MCP sample by continuity of care level. For the 50,499 individuals in the study sample the mean age was 44.41 (standard deviation 18.20) and 56.1 % were female. The overall average COC index value was 0.705. Almost 51 % of the sample fell into the high continuity group with a COC value of 0.75 or greater, 21 % fell into the medium continuity group and 28% into the low continuity group. Statistically significant differences existed between continuity of care groups (low, medium, or high) with relation to all measures including gender, mean age, 15-year age category,

Continuity and outcomes Measured Over 4-year Period

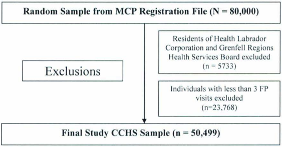

Figure 4.2 Sample Selection - Phase II (MCP Sample)

Table 4.13: Socio-demographic and health status variables by Continuity of Care Level Continuity and Outcomes over 4 years (1999-2002); Ages 12+ (N=50,499)

Characteristic	Low Continuity COC < 0.5	Medium Continuity 0.5≤COC<0.75	High Continuity COC ≥ 0.75	Total	p-value
	[Count (%)]				
n (% of Sample)	14,123 (28.0)	10,625 (21.0)	25,751 (51.0)	50,499 (100)	--
Gender					
Male	5779 (40.9)	4303 (40.5)	12,095 (47.0)	22,177 (43.9)	<0.001*
Female	8344 (59.1)	6322 (59.5)	13,656 (53.0)	28,322 (56.1)	
Age (years)					
Mean (SD)	38.65 (18.19)	43.36 (18.28)	47.99 (17.96)	44.41 (18.53)	<0.001*
Age Groups					
12-19	2480 (17.6)	1176 (11.1)	1759 (6.8)	5415 (10.7)	<0.001*
20-44	6929 (49.1)	4755 (44.8)	9745 (37.8)	21,429 (42.4)	
45-64	3257 (23.1)	3224 (30.3)	927 (36.0)	15,757 (31.2)	
65-74	788 (5.6)	815 (7.7)	2913 (11.3)	4516 (8.9)	
75+	669 (4.7)	655 (6.2)	2058 (8.0)	3382 (6.7)	
Income Quintile					
1 (Low)	1783 (13.4)	1490 (14.9)	4059 (16.8)	7332 (15.5)	<0.001*
2	2175 (16.4)	1639 (16.4)	4613 (19.1)	8427 (17.8)	
3	2626 (19.8)	2148 (21.5)	5226 (21.6)	10,000 (21.1)	
4	3473 (26.2)	2443 (24.5)	5530 (22.9)	11,446 (24.2)	
5 (High)	3212 (24.2)	2253 (22.6)	4724 (19.6)	10,189 (21.5)	
Rural/Urban					
Urban	5727 (40.9)	4579 (43.5)	11,942 (46.7)	22,248 (44.4)	<0.001*
Rural	8724 (59.1)	5939 (56.5)	13,610 (53.3)	27,823 (55.6)	
Number of Chronic Conditions					
Mean (SD)	1.27 (1.29)	1.46 (1.35)	1.52 (1.36)	1.44 (1.34)	<0.001*
0	4503 (31.9)	2775 (26.1)	6269 (24.3)	13,547 (26.8)	<0.001*
1	4865 (34.4)	3589 (33.8)	8460 (32.9)	16,914 (33.5)	
2+	4755 (33.7)	4261 (40.1)	11,022 (42.8)	20,038 (39.7)	
Family Physician (FP) Visits					
Number of Visits (Mean (SD))	17.26 (16.79)	19.85 (17.36)	20.00 (19.67)	19.20 (18.46)	<0.001*
3-10	6017 (42.6)	3483 (32.8)	9292 (36.1)	18,792 (37.2)	<0.001*
11-20	4071 (28.8)	3381 (31.8)	7430 (28.9)	14,882 (29.5)	
21+	4035 (28.6)	3761 (35.4)	9029 (35.1)	16,825 (33.3)	

* indicates $p < 0.05$

income quintile and rural/urban status. In progressing from the low to the high continuity group patients were more likely to be male and older, more like to be in a lower income category, and more likely to be from an urban area.

There were statistically significant differences between continuity of care groups for all health status co-variates, including mean number of chronic conditions, chronic-conditions category, mean number of FP visits and FP-visit category. Number of chronic conditions increased with increasing continuity level. Mean number of FP visits increased with increasing continuity with only a small increase seen between the medium and high continuity groups. For FP-visit category, the medium continuity group was more likely to have a high number of FP visits (i.e. 21+) than the low continuity group. The high continuity group was intermediate between the low and medium groups with respect distribution across FP-visit categories.

Descriptive statistics were also run for 55+, 65+, and 75+ age groups as well as the 12-19, 20-44, 45-64, and 65-74 age groups (Tables M7-M13). At older age groups there fewer differences in co-variates between continuity groups.

4.2.2.2 Health Care Services Utilization Outcomes

Table 4.14 presents descriptive statistics for per-patient health care utilization measures for the overall study sample. Patients had a total of 969,612 home and office fee-for-service FP visits over the four-year study period for a mean of 19.20 FP visits per patient over four years; 72.6 % of the sample had a least one specialist contact during the study period while 54.9 % of the sample had at least one ambulatory specialist visit.

Table 4.14: Descriptive Statistics for Per-Person Health Care Services Utilization for 4-year Period (± 2 Years from Survey Date) (N=50,499)

Measure	Mean (SD) (per Person)	Median	Minimum	Maximum
Total FP Visits (H&O)	19.20 (18.46)	14	3	627
Total Specialists Contacts	17.28 (26.48)	9	0	691
Ambulatory Specialist Contacts	4.93 (8.35)	2	0	199
Inpatient Hospital Separations	0.53 (1.31)	0	0	74
Inpatient Hospital Separations For ACSCs	0.05 (0.376)	0	0	13

Patients had a total of 872,766 specialists contacts, 249,028 of which were ambulatory visits yielding means of 17.28 per person for total specialist contacts and 4.93 for ambulatory specialists visits over four years; 21.3 % of the sample had at least one acute (inpatient) hospitalization and 3.3% had at least one hospitalization for an ACSC. Patients were hospitalized a total of 26,806 times, 2710 of which were for ACSCs resulting in means of 0.53 hospitalizations per person and 0.05 for hospitalizations for ACSCs per person over four years. All five utilization measures were positively-skewed with FP and specialists contacts being the most variable and hospital separations for ACSCs and FP visits being the most skewed.

Table 4.15 presents specialist utilization outcomes by continuity of care level for the following age groups: 12+ (all ages), 55+, 65+, and 75+. For total specialist contacts statistically-significant differences existed between continuity of care groups for all four age groups. For the 12+ age group, number of specialist contacts increased with increasing continuity level while for the 55+ age group those with medium continuity tended to have the highest number of contacts. For the 65+ group, the low and medium continuity groups had similar numbers of contacts, both tending to be greater than the low continuity group. For ambulatory specialist contacts statistically-significant

Table 4.15: Specialist Utilization by Continuity Group and Age Group (MCP Sample) Continuity and Outcomes over same 4-year period (1999-2002)

Type of Physician	Age Grp (Yrs)	Continuity of Care Level				p-value
		Low (<0.5)	Medium (0.5-0.74)	High (≥ 0.75)	Overall	
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Total Specialist Contacts[1]	12+	15.07 (24.83)	17.95 (26.86)	18.22 (27.11)	17.28 (26.48)	<0.001*
	55+	28.28 (37.69)	29.54 (39.72)	26.56 (34.45)	27.44 (36.12)	0.001*
	65+	31.38 (43.62)	31.42 (41.77)	28.66 (37.11)	29.68 (39.29)	0.050*
	75+	30.74 (34.26)	29.24 (34.55)	26.36 (32.43)	27.79 (33.26)	0.005*
Ambulatory Specialist Contacts[1]	12+	4.55 (8.28)	5.16 (8.24)	5.04 (8.42)	4.93 (8.35)	<0.001*
	55+	7.10 (11.36)	7.00 (9.02)	6.64 (9.71)	6.79 (9.91)	0.003*
	65+	7.35 (11.86)	7.03 (8.76)	6.75 (9.73)	6.91 (10.00)	0.066
	75+	7.04 (13.03)	6.30 (7.99)	5.89 (8.82)	6.20 (9.67)	0.094

[1]Number of contacts per person over 4-year period * indicates $p < 0.05$

differences existed for the 12+ and 55+ age groups only, In the 12+ age group the low continuity group had the lowest utilization while in the 55+ group the low continuity group had the highest utilization. There were no differences seen with respect to number of ambulatory specialist contacts for the 65+ or 75+ groups.

Table 4.16 presents hospital utilization outcomes by continuity of care level for the same age groups used for the previous specialist data. Significant differences in number of hospital separations between continuity groups existed only for the 12+ and 75+ age groups. For the 12+ age group the number of hospitalizations tended to increase with increasing continuity level while for the 75+ age group the number tended to decrease with increasing continuity. There were no significant differences in hospital separations between continuity groups for the 55+ and 65+ age groups.

For hospitalizations for ACSCs there were significant differences seen between continuity groups for the 12+ and 75+ age groups. For the 12+ age group number of

Table 4.16: Inpatient Hospital Utilization by Continuity Group and Age Group (MCP Sample) Continuity and Outcomes over same 4-year period (1999-2002)

Type of Hospitalization	Age Group (Years)	Continuity of Care Level				p-value
		Low (<0.5)	Med. (0.5-0.74)	High (≥0.75)	Overall	
		Mean (SD)	Mean (SD)	Mean (SD.)	Mean (SD)	
Total Hospital Separations[1]	12+	0.46 (1.32)	0.55 (1.36)	0.56 (1.29)	0.53 (1.31)	<0.001*
	55+	1.00 (1.80)	1.03 (1.98)	0.93 (1.68)	0.96 (1.77)	0.327
	65+	1.30 (2.01)	1.28 (2.17)	1.17 (1.88)	1.22 (1.96)	0.156
	75+	1.62 (2.21)	1.53 (2.34)	1.35 (1.98)	1.44 (2.11)	0.015*
Hospitalizations for ACSCs[1]	12+	0.04 (0.30)	0.05 (0.40)	0.06 (0.40)	0.05 (0.38)	<0.001*
	55+	0.16 (0.63)	0.17 (0.71)	0.15 (0.62)	0.15 (0.64)	0.134
	65+	0.24 (0.77)	0.25 (0.88)	0.21 (0.75)	0.22 (0.78)	0.064
	75+	0.33 (0.95)	0.34 (0.99)	0.24 (0.74)	0.28 (0.84)	0.012*

[1]Number of hospital separations per person over 4-year period * indicates $p < 0.05$

hospitalizations increased with increasing continuity. For the 75+ age group the low- and medium-continuity groups had a similar number of hospitalizations while the number of hospitalizations was lowest for the high continuity group.

In Phase II, as described in the 'Methodology' section, analyses were also carried out by a second set of age groups (ages 12-19, 20-44, 45-64, 65-74, and 75+, with the latter age group already having been used above in the first set of age groups). Tables 4.17 and 4.18 present specialist and hospital utilization data by continuity of care level by the second set of age groups. For specialist contacts, there were statistically-significant differences across continuity levels for all age groups except age 65-74. For ambulatory specialist contacts there were statistically-significant differences across continuity levels for the three lower age groups but not for the 65-74 and 75+ age groups. For both total specialist and ambulatory specialist contacts, the medium continuity group tended to

Table 4.17: Specialist Utilization by Continuity Group by Age Group (MCP Sample) Continuity and Outcomes over same 4-year period (1999-2002)

Type of Physician	Age Grp (Yrs)	Continuity of Care Level				p-value
		Low (<0.5)	Med. (0.5-0.74)	High (≥0.75)	Overall	
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Total Specialist Contacts[1]	12-19	7.79 (13.88)	8.64 (13.14)	8.24 (13.22)	8.12 (15.31)	0.003*
	20-44	11.77 (18.18)	13.32 (18.71)	12.43 (18.84)	12.42 (18.61)	<0.001*
	45-64	20.36 (27.63)	22.03 (29.99)	20.59 (27.91)	28.84 (20.08)	<0.001*
	65-74	31.92 (50.23)	33.19 (46.71)	30.28 (40.01)	31.09 (43.21)	0.400
	75+	30.74 (34.26)	29.24 (34.55)	26.36 (32.43)	27.79 (33.26)	0.005*
Ambulatory Specialist Contacts[1]	12-19	2.67 (5.50)	2.97 (5.03)	2.71 (5.07)	2.75 (5.26)	0.004*
	20-44	4.08 (7.38)	4.56 (8.20)	4.01 (7.52)	4.15 (7.64)	<0.001*
	45-64	5.75 (9.35)	6.00 (8.74)	5.65 (8.80)	5.75 (8.90)	<0.001*
	65-74	7.60 (10.77)	7.61 (9.29)	7.36 (10.29)	7.45 (10.20)	0.234
	75+	7.04 (13.03)	6.30 (7.99)	5.89 (8.82)	6.20 (9.67)	0.094

[1]Number of contacts per person over 4-year period * indicates $p < 0.05$

Table 4.18: Hospital Utilization by Continuity Group by Age Group (MCP Sample) Continuity and Outcomes over same 4-year period (1999-2002)

Type of Hospitalization	Age Group (Years)	Continuity of Care Level				p-value
		Low (<0.5)	Medium (0.5-0.74)	High (≥0.75)	Overall	
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Total Hospital Separations[1]	12-19	0.27 (0.99)	0.28 (0.86)	0.28 (0.743)	0.27 (0.89)	0.050*
	20-44	0.35 (1.23)	0.42 (1.08)	0.38 (0.978)	0.38 (1.09)	<0.001*
	45-64	0.45 (1.20)	0.50 (1.29)	0.49 (1.16)	0.48 (1.19)	0.034*
	65-74	1.03 (1.78)	1.07 (2.01)	1.05 (1.79)	1.05 (1.83)	0.623
	75+	1.62 (2.21)	1.53 (2.34)	1.35 (1.98)	1.44 (2.11)	0.015*
Hospitalizations for ACSCs[1]	12-19	0.01 (0.13)	0.01 (0.10)	0.01 (0.12)	0.01 (0.12)	0.936
	20-44	0.01 (0.09)	0.01 (0.12)	0.01 (0.15)	0.01 (0.13)	0.170
	45-64	0.04 (0.28)	0.05 (0.33)	0.05 (0.34)	0.05 (0.33)	0.126
	65-74	0.16 (0.57)	0.18 (0.77)	0.19 (0.74)	0.18 (0.72)	0.821
	75+	0.33 (0.95)	0.34 (0.99)	0.24 (0.74)	0.28 (0.84)	0.012*

[1]Number of Hospital separations per person over 4-year period   * indicates $p < 0.05$

have the highest number of contacts, except for the for the 75+ age group where the low continuity group tended to have the highest number.

For number of hospital separations, significant differences between continuity levels existed for the 12-19, 20-44, 45-64, and 75+ age groups but not for the 65-74 age group. This pattern was similar to that seen with total specialist visits above. As with specialist visits, the medium continuity group tended to have the highest number of hospital separations, except for the 75+ age group where the low continuity group tended to have the highest. For hospitalizations for ACSCs a significant difference between continuity groups was found only in the 75+ group where the low and medium continuity groups had a similar number of hospitalizations while the number of hospitalizations was lowest for the high continuity group.

4.2.3 Multivariate Analysis

Backward conditional regression analysis was used to investigate the relationship of continuity of care and co-variates with each of the health care utilization outcomes for the whole sample (i.e. ages 12+). Model fit characteristics were similar to those in Phase I. Thus, as in Phase I, the Poisson model was used for the regression models involving hospital separations (and hospital separations for ACSCs here) and the negative binomial model for the regression models involving the two specialist measures. For the model for hospital separations for ACSCs the chronic conditions co-variate was removed from the model given that the majority of the ACSCs used in the study were chronic conditions. Results are presented in terms of rate ratios, which are equal to the anti-log of the regression co-efficient.

Table 4.19 presents the results of the final step of a backward condition regression involving factors associated with number of hospital separations for the whole sample (i.e. ages 12+). Medium continuity was associated with a 5 % increase in hospital separations relative to high continuity while there was no difference in hospital separations between the low and high continuity groups. Other factors associated with number of hospital separations included age, gender, number of chronic illnesses, income quintile, rural/urban status, and number of FP visits.

Table 4.20 shows results of the final step of a backward conditional regression for factors associated with hospital separations for ACSCs. Being in the medium continuity group was associated with a 13.2 % increase in the number of hospitalizations for ACSCs relative to the high continuity group while there was no significant differences in number

Table 4.19: Factors Associated with Inpatient Hospitalizations (Poisson Regression) Continuity and Outcomes over 4 years (1999-2002); Ages 12+ (N=50,499)

Characteristic	Adjusted Rate Ratio (95 % C.I.)
Continuity of FP Care	
High (> 0.75)	**1.000**
Medium (>0.5 but < 0.75)	1.050* (1.018-1.084)
Low (< 0.5)	1.025 (0.994-1.058)
Age	1.015* (1.014-1.016)
Gender	
Female	1.039* (1.320-1.454)
Number of Chronic Conditions	
0	**1.000**
1	1.012 (0.968-1.058)
2+	1.798* (1.721-1.878)
Income	
Q1	**1.000**
Q2	1.386* (1.320-1.454)
Q3	1.300* (1.240-1.362)
Q4	1.192* (1.143-1.244)
Q5	1.122* (1.077-1.169)
Rural/Urban	
Rural	**1.000**
Urban	0.926* (0.898-0.954)
Number of FP Visits	
High	**1.000**
Medium	0.660* (0.640-0.680)
Low	0.528* (0.509-0.548)

* indicates significant difference from reference group

Table 4.20: Factors Associated with Inpatient Hospitalizations for ACSCs (Negative Binomial Regression) Continuity and Outcomes over 4 years (1999-2002); Ages 12+ (N=50,499)

Characteristic	Adjusted Analysis Rate Ratio (95 % C.I.)
Continuity of FP Care	
High (≥ 0.75)	**1.000**
Medium (>0.5 but < 0.75)	1.132* (1.026-1.250)
Low (< 0.5)	1.017 (0.916-1.128)
Age	1.063* (1.061-1.066)
Gender	
Female	0.681* (0.629-0.737)
Income	
Q1	**1.000**
Q2	2.108* (1.798-2.472)
Q3	1.807* (1.546-2.113)
Q4	1.345* (1.156-1.564)
Q5	1.243* (1.071-1.443)
Rural/Urban	
Rural	**1.000**
Urban	0.826* (0.751-0.909)
Number of FP Visits	
High	**1.000**
Medium	0.472* (0.426-0.524)
Low	0.401* (0.359-0.448)

* indicates significant difference from reference group

of hospitalizations for ACSCs between the low and high continuity groups. Other factors associated with number of hospitalizations for ACSCs were age, gender, income quintile, rural/urban status and number of FP visits.

Table 4.21 presents the results of the final step of a backward conditional regression involving factors associated with number of specialist contacts. Medium continuity was associated with a 2.7 % increase in specialist contacts relative to high continuity while there was no difference in specialist contacts between the low and high continuity groups. Other factors associated with number of specialist contacts included age, gender, number of chronic illnesses, rural-urban status and number of FP visits.

Table 4.22 presents the results of the final step of a backward conditional regression involving factors associated with number of ambulatory specialist contacts. Medium continuity was associated with a 4.1 % increase in ambulatory specialist contacts relative to high continuity while there was no difference in ambulatory specialist contacts between the low and high continuity groups. Other factors associated with number of ambulatory specialist contacts included age, gender, number of chronic illnesses, rural-urban status, income quintile (relative to the lowest income category), and number of FP visits.

Tables for similar regression analyses for age groups 55+, 65+ and 75+ as well as for the 12-19, 20-44, 45-64, and 65-74 age groups are presented in Appendix N.

Table 4.23 presents a summary of the rate ratios for the continuity of care variable in the regression analysis for each health outcome by age group (12+, 55+, 65+, and 75+). Table 4.23A presents rate ratios for continuity and hospital separations. In the 12+

Table 4.21: Factors Associated with Specialists Visits (Negative Bimomial Regression) Continuity and Outcomes over 4 years (1999-2002); Ages 12+ (N=50,499)

Characteristic	Adjusted Rate Ratio (95 % C.I.)
Continuity of FP Care	
High (≥ 0.75)	**1.000**
Medium (>0.5 but < 0.75)	1.027* (1.002-1.053)
Low (< 0.5)	0.974* (0.951-0.997)
Age	1.013* (1.012-1.014)
Gender	
Female	1.066* (1.045-1.088)
Number of Chronic Conditions	
0	**1.000**
1	1.254* (1.221-1.287)
2+	1.827* (1.773-1.881)
Income	
Q1	**1.000**
Q2	1.029 (0.991-1.069)
Q3	0.995 (0.961-1.032)
Q4	1.013 (0.982-1.045)
Q5	0.973 (0.945-1.002)
Rural/Urban	
Rural	**1.000**
Urban	1.203* (1.174-1.233)
Number of FP Visits	
High	**1.000**
Medium	0.682* (0.665-0.699)
Low	0.470* (0.458-0.483)

* indicates significant difference from reference group

Table 4.22: Factors Associated with Ambulatory Specialist Visits (Negative Binomial Regression) Continuity and Outcomes over 4 years (1999-2002); Ages 12+ (N=50,499)

Characteristic	**Adjusted Analysis Rate Ratio (95 % C.I.)**
Continuity of FP Care	
High (≥ 0.75)	**1.000**
Medium (>0.5 but < 0.75)	1.041* (1.009-1.074)
Low (< 0.5)	1.008 (0.979-1.037)
Age	1.007* (1.006-1.008)
Gender	
Female	1.061* (1.034-1.087)
Number of Chronic Conditions	
0	**1.000**
1	1.195* (1.157-1.236)
2+	1.635* (1.576-1.696)
Income	
Q1	**1.000**
Q2	0.920* (0.878-0.963)
Q3	0.840* (0.804-0.878)
Q4	0.912* (0.878-0.948)
Q5	0.904* (0.873-0.938)
Rural/Urban	
Rural	**1.000**
Urban	1.468* (1.425-1.513)
Number of FP Visits	
High	**1.000**
Medium	0.653* (0.633-0.674)
Low	0.411* (0.397-0.424)

* indicates significant difference from reference group

Table 4.23: Summary of Log-Linear Regressions - MCP Sample (N=50,499)
(Continuity and Outcomes measured over the same 4 year period)
(First Set of Age Groups)

Table 4.23A: Continuity and Inpatient Hospitalization (1999-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	**1.00**	1.050* (1.018-1.084)	1.026 (0.994-1.058)
55+	**1.00**	1.082* (1.035-1.132)	1.049* (1.001-1.098)
65+	**1.00**	1.077* (1.020-1.137)	1.074* (1.017-1.134)
75+	**1.00**	1.117* (1.037-1.205)	1.193* (1.109-1.285)

* indicates significant difference from reference group

Table 4.23B: Continuity and Inpatient Hospitalization for Ambulatory Care Sensitive Conditions (1999-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	**1.00**	1.132* (1.026-1.250)	1.017 (0.916-1.128)
55+	**1.00**	1.190* (1.066-1.329)	1.088 (0.967-1.223)
65+	**1.00**	1.253* (1.107-1.418)	1.154* (1.015-1.314)
75+	**1.00**	1.502* (1.274-1.771)	1.400* (1.181-1.660)

* indicates significant difference from reference group

Table 4.23C: Continuity and Specialist Visits (1999-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	**1.00**	1.027* (1.002-1.053)	0.974* (0.951-0.997)
55+	**1.00**	1.077* (1.029-1.128)	1.059* (1.011-1.109)
65+	**1.00**	1.069* (1.005-1.173)	1.102* (1.037-1.153)
75+	**1.00**	1.067 (0.975-1.168)	1.175* (1.073-1.285)

* indicates significant difference from reference group

Table 4.23D: Continuity and Ambulatory Specialist Visits (1999-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	**1.00**	1.041* (1.009-1.074)	1.007 (0.979-1.037)
55+	**1.00**	1.047* (1.007-1.089)	0.997 (0.962-1.032)
65+	**1.00**	1.044* (1.009-1.081)	0.999 (0.968-1.032)
75+	**1.00**	1.046* (1.013-1.081)	1.006* (0.976-1.037)

* indicates significant difference from reference group

sample, as indicated previously, being in the medium continuity group was associated with a 5% increase in hospital separations relative to the high continuity group while there was no significant difference in hospital separations between the low and high continuity groups. If there was a relationship between continuity of care and outcomes, one would have expected the low continuity group to be associated with more of an increase in hospital separations than the medium continuity group. As in the 55+ age group in the CCHS analysis (Phase I), the magnitude of the increase is slightly smaller for the low continuity group than for the medium group. For the 75+ age group we see a shift to the expected pattern where the magnitude of the increase in hospital separations becomes greater for the low continuity group with the medium continuity group having an 11.7 % increase is hospital separations and the low continuity group a 19.3 % increase. The shift was similar to that seen in Phase I with the CCHS sample except that the shift for the CCHS sample occurred with the 65+ age group.

For hospitalizations for ACSCs (Table 4.23B), as stated above, for the 12+ age group the medium continuity group was associated with a 13.2% increase in hospitalizations for ACSCs relative to the high continuity group while there was no difference in number of hospitalizations for ACSCs between the low and high continuity groups. In the 65+ and 75+ age groups the magnitude of differences in hospitalizations for ACSCs between continuity groups is greater than that seen with total hospitalizations in Table 4.23A above. Although these between-group differences in hospitalization for ACSCs increased with age, the medium continuity group maintains a slightly higher difference than the low continuity group at the 65+ and 75+ age groups and we do not see a shift to where the low continuity has the greatest difference as seen with total hospitalizations. For the 75+ age group the medium- and low-continuity groups have, respectively, 50.2% and 40.0% more hospitalizations than the high continuity group.

Table 4.23C presents rate ratios for specialist contacts. Here we see a similar pattern to that seen with total hospital separations above, except that the expected shift happens in the 65+ age group with the medium continuity group having a 6.9% increase in specialist contacts relative to high continuity and the low continuity group having a 10.2 % increase. For the 75+ age group the low continuity group saw a 17.5% increase relative to high continuity while there was no significant difference in number of specialist contacts between the medium and high continuity groups.

In Table 4.23D, for ambulatory specialist contacts, there was a significant increase for the medium continuity group relative to high continuity, which was similar in magnitude for all age groups. For the low continuity group a very small but significant increase was seen only at the 75+ age group.

Table 4.24 presents a summary of the rate ratios for the continuity of care variable in the regression analysis for each health outcome by a second set of age groups (12+ (all ages), 12-19, 20-44, 45-64, 65-74, and 75+).

For hospital separations, significant decreases were seen for the 12-19 (17.5%) and 20-44 (15.1%) age groups for the low continuity group. Significant increases were seen for the medium continuity group in the 12+ age group (5%) and for both medium (11.7%) and low (19.3%) continuity groups in the 75+ age group (Table 4.24A).

For hospitalizations for ACSCs significant increases were seen for the medium (13.2%) continuity group in the 12+ age group and for both the low (40.0%) and medium (50.2%) continuity groups in the 75+ age group (Table 4.24B). For specialist contacts a significant decrease (12.4%) was seen in the low continuity group for the 12-19 age group. Significant increases were seen in the medium continuity group for the 12+ (2.7%) age group, and for the low continuity group (15.6%) in the 75+ age group (Table 4.24C). For ambulatory specialist contacts a significant increase was seen for the low continuity group in the 45-64 (7.0%) and 75+ age groups (21.8%) (Table 4.24D).

4.3 Longitudinal Analysis of Sample from the MCP Registry File (Continuity measured from 1999-2000 and health care services utilization outcomes measured from 2001-2002)

4.3.1 Sample and Exclusions

Figure 4.3 presents the results of the procedure by which the final study sample for the longitudinal analysis of Phase II was obtained including exclusions of study participants. A sample of 80,000 individuals was selected from the MCP registration file and 5733 individuals who were residents of the Labrador and Grenfell regions were excluded from the sample. Finally, the 31,665 survey participants with less than three FP visits during the study period were also excluded from the sample. This left a final MCP sample of 42,602 which was used for the second (longitudinal) analysis in Phase II of the study, which was approximately 8000 fewer than the sample used for the first analysis of Phase II, which involved examining continuity and outcomes over the same four-year period.

Table 4.24 Summary of Log-Linear Regressions - MCP Sample (N=50,499) (Continuity and Outcomes measured over the same 4 year period) (Second Set of Age Groups)

Table 4.24A: Continuity and Inpatient Hospitalization (1999-2002) (Poisson Regression)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	1.00	1.050* (1.018-1.084)	1.026 (0.994-1.058)
12-19	1.00	0.869 (0.753-1.003)	0.825* (0.748-0.953)
20-44	1.00	0.991 (0.936-1.048)	0.849* (0.805-0.896)
45-64	1.00	1.018 (0.959-1.080)	1.002 (0.943-1.066)
65-74	1.00	1.043 (0.964-1.128)	0.958 (0.883-1.039)
75+	1.00	1.117* (1.054-1.226)	1.193* (1.131-1.312

* indicates significant difference from reference group

Table 4.24B: Continuity and Inpatient Hospitalization for Ambulatory Care Sensitive Conditions (1999-2002) (Poisson Regression)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	1.00	1.132* (1.026-1.250)	1.017 (0.916-1.128)
12-19	1.00	0.774 (0.340-1.763)	0.878 (0.454-1.698)
20-44	1.00	1.028 (0.719-1.470)	0.678 (0.465-0.990)
45-64	1.00	0.876 (0.711-1.081)	0.988 (0.816-1.197)
65-74	1.00	1.018 (0.842-1.230)	0.921 (0.753-1.126)
75+	1.00	1.502* (1.274-1.771)	1.400* (1.181-1.660)

* indicates significant difference from reference group

Table 4.24C: Continuity and Specialist Visits (1999-2002) (Negative Binomial Regression)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	1.00	1.027* (1.002-1.053)	0.974 (0.951-0.997)
12-19	1.00	0.985 (0.897-1.081)	0.886* (0.820-0.958)
20-44	1.00	1.020 (0.980-1.061)	0.958 (0.925-0.999)
45-64	1.00	1.032 (0.990-1.076)	1.030 (0.988-1.073)
65-74	1.00	1.091 (1.004-1.185)	1.052 (0.967-1.144)
75+	1.00	1.044 (0.954-1.143)	1.156* (1.056-1.266)

* indicates significant difference from reference group

Table 4.24D: Continuity and Ambulatory Specialist Visits (1999-2002) (Negative Binomial Regression)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	**1.00**	1.021 (0.990-1.053)	0.977 (0.949-1.006)
12-19	**1.00**	1.016 (0.903-1.142)	0.902 (0.818-0.999)
20-44	**1.00**	1.063 (1.011-1.118)	1.002 (0.958-1.050)
45-64	**1.00**	1.034 (0.982-1.089)	1.070* (1.016-1.128)
65-74	**1.00**	1.056 (0.964-1.156)	1.085 (0.990-1.189)
75+	**1.00**	1.033 (0.931-1.146)	1.218* (1.099-1.350)

* indicates significant difference from reference group

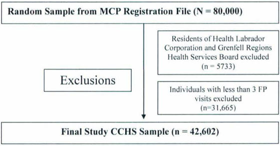

Figure 4.3 Sample Selection - Phase II (MCP Sample)
(Continuity measured from 1999-2000 and outcomes from 2001-2002)

4.3.2 Descriptive Statistics

4.3.2.1 Main Predictor Variable and Co-variates

Table 4.25 presents socio-demographic and health status variables by continuity of care level. For the 42,602 individuals in the study sample the mean age was 45.5

(standard deviation 18.67) and 58.8 % were female. The overall average COC index value was 0.738. Almost 56 % of the sample fell into the high continuity group with a COC value of 0.75 or greater, 19.6 % fell into the medium continuity group and 24.5% into the low continuity group. Statistically significant differences existed between continuity of care groups (low, medium, or high) with relation to all measures including gender, mean age, 15-year age category, income quintile, and rural/urban status. In progressing from the low to the high continuity group patients were more likely to be older (and in a lower age category), in a lower income quintile, and from an urban area. Patients in the high continuity group were more likely to be male than those falling into the medium- or low continuity-groups.

There were statistically significant differences between continuity of care groups for all health status co-variates, including mean number of chronic conditions, chronic-conditions category, mean number of FP visits and FP-visit category. Number of chronic conditions increased with increasing continuity. Mean number of FP visits was highest in the high continuity group and lowest in the low continuity group. For FP-visit category, the medium-continuity group was more likely to have a high number of FP visits (i.e. 12+) than the low-continuity group. The high continuity group was intermediate between the low and medium groups with respect distribution across FP-visit categories.

Table 4.25: Socio-demographics by Continuity of Care Level
Continuity (1999-2000) and Outcomes (2001-2002); Ages 12+ (N=42,602)

Characteristic	Low Continuity COC < 0.5	Medium Continuity 0.5 ≤ COC < 0.75	High Continuity COC ≥ 0.75	Total	p-value
	[Count (%)]				
n (% of Sample)	10,425 (24.5)	8343 (19.6)	23,834 (55.9)	42,602 (100)	--
Gender					
Male	3957 (38.0)	3128 (37.5)	10,447 (43.8)	17,532 (41.2)	<0.001*
Female	6468 (62.0)	5215 (62.5)	13,387 (56.2)	25,070 (58.8)	
Age (years)					
Mean (SD)	39.5 (18.34)	43.9 (18.33)	48.8 (18.21)	45.5 (18.67)	<0.001*
Age Groups					
12-24	2745 (26.3)	1399 (16.8)	2556 (10.7)	6700 (15.7)	<0.001*
25-39	3014 (28.9)	2361 (28.3)	5232 (22.0)	10,607 (24.9)	
40-54	2617 (25.1)	2415 (28.9)	7387 (31.0)	12,419 (29.2)	
55-69	1243 (11.9)	1295 (15.5)	5214 (21.9)	7752 (18.2)	
70+	806 (7.7)	873 (10.5)	3445 (14.5)	5124 (12.0)	
Income Quintile					
1 (Low)	1374 (14.0)	1128 (14.4)	3619 (16.2)	6121 (15.3)	<0.001*
2	1526 (15.6)	1322 (16.9)	4222 (18.9)	7070 (17.7)	
3	2007 (20.5)	1604 (20.5)	4830 (21.6)	8441 (21.1)	
4	2567 (26.2)	1978 (25.2)	5218 (23.3)	9763 (24.4)	
5 (High)	2338 (23.8)	1802 (23.0)	4474 (20.0)	8614 (21.5)	
Rural/Urban					
Urban	4921 (41.5)	3516 (42.5)	10,783 (45.6)	18,590 (44.0)	<0.001*
Rural	6039 (58.5)	4761 (57.5)	12,849 (54.4)	23,649 (56.0)	
Number of Chronic Conditions					
Mean (SD)	1.36 (1.28)	1.60 (1.39)	1.65 (1.39)	1.57 (1.37)	<0.001*
0	2887 (27.7)	1824 (21.9)	5015 (21.0)	9726 (22.8)	<0.001*
1	3679 (35.3)	2749 (32.9)	7589 (31.8)	14,017 (32.9)	
2+	3859 (37.0)	3770 (45.2)	11,230 (47.1)	18,859 (44.3)	
Family Physician (FP) Visits					
Number of FP Visits (Mean (SD))	10.47 (9.65)	12.45 (10.14)	12.18 (11.78)	11.82 (11.01)	<0.001*
3-6	4308 (41.3)	2546 (30.5)	8137 (34.1)	14,991 (35.2)	<0.001*
7-10	2530 (24.3)	1944 (23.3)	5611 (23.5)	10,085 (23.7)	
12+	3587 (34.4)	3853 (46.2)	10,086 (42.3)	17,526 (41.1)	

* indicates $p < 0.05$

Descriptive statistics were also run for 55+, 65+, and 75+ age groups as well as the 12-19, 20-44, 45-64, and 65-74 age groups (Tables M14-M20). At older age groups there fewer differences in co-variates between continuity groups.

4.3.2.2 Health Care Services Utilization Outcomes

Table 4.26 presents descriptive statistics for per-patient health care utilization measures for the overall study sample. Patients had 503,481 home and office fee-for-service FP visits over the two-year study period for a mean of 11.82 FP visits per patient over two years; 78.1 % of the sample had at least 1 specialist contact during the study period while 55.4 % of the sample had at least 1 ambulatory specialist visit. Patients had a total of 378,462 specialists contacts, 104,046 of which were ambulatory visits yielding means of 8.88 per person for total specialist contacts and 2.44 for ambulatory specialists visits over two years; 16.6 % of the sample had at least one acute (inpatient) hospitalization and 3.7 % had at least 1 hospitalization for an ACSC. Patients were hospitalized a total of 21,503 times, 2542 of which were for ACSCs resulting in a mean of 0.27 hospitalizations per person and 0.06 for hospitalizations for ACSCs over two years. All five utilization measures were positively-skewed with specialists visit being most variable and hospitalizations for ACSCs the most skewed. Hospitalization for ACSCs was the least variable and ambulatory specialist contacts the least skewed.

Table 4.27 presents specialist utilization outcomes by continuity of care level for the following age groups: 12+ (all ages), 55+, 65+, and 75+. For total and ambulatory specialist contacts, statistically-significant differences existed between continuity of care

Table 4.26: Descriptive Statistics for Per-Person Health Care Services Utilization for 2-year period (2001-2002) (N=42,602)

Measure	Mean (SD) (per Person)	Median	Minimum	Maximum
Total FP Visits (H&O)	11.82 (11.06)	9	3	579
Total Specialists Contacts	8.88 (15.86)	4	0	478
Ambulatory Specialist Contacts	2.44 (4.41)	1	0	95
Inpatient Hospital Separations	0.27 (0.81)	0	0	37
Inpatient Hospital Separations For ACSCs	0.06 (0.398)	0	0	13

Table 4.27: Physician Utilization by Continuity Group by Age Group (MCP Sample) Continuity (1999-2000) and Outcomes (2001-2002)

Type of Physician	Age Grp (Yrs)	Continuity of Care Level				p-value
		Low (<0.5)	Medium (0.5-0.74)	High (≥0.75)	Overall	
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Total Specialist Contacts[1]	12+	7.50 (13.07)	9.43 (17.12)	9.30 (16.48)	8.88 (15.86)	<0.001*
	55+	12.45 (17.56)	14.94 (26.18)	13.23 (21.19)	13.39 (21.61)	0.007*
	65+	12.86 (18.58)	15.80 (28.14)	13.92 (23.30)	14.08 (23.56)	0.047*
	75+	11.32 (17.65)	12.60 (17.59)	12.62 (21.39)	12.40 (20.20)	0.123
Ambulatory Specialist Contacts[1]	12+	2.17 (4.09)	2.67 (4.80)	2.48 (4.39)	2.44 (4.41)	<0.001*
	55+	3.01 (4.64)	3.44 (5.18)	3.16 (4.92)	3.18 (4.93)	0.003*
	65+	2.97 (4.72)	3.40 (5.36)	3.09 (4.70)	3.12 (4.83)	0.029*
	75+	2.50 (4.91)	2.88 (5.76)	2.56 (3.85)	2.60 (4.42)	0.215

[1]Number of contacts per person over 2-year period * indicates $p < 0.05$

groups for all age groups except the 75+ group. For the three lower age groups those in the low-continuity group had the lowest number of total and ambulatory specialist visits while the medium-continuity group had the highest.

Table 4.28 presents hospital utilization outcomes by continuity of care level for the same age groups used for the previous specialist data. As in the specialist data, significant differences in number of hospital separations between continuity groups existed in all age groups save the 75+ group. For the 55+ and 65+ age groups the medium-continuity group tended to have the highest number of hospital separations while the low-continuity group tended to have the lowest. For the 12+ group the medium- and high-continuity groups had similar numbers of hospital separations.

For hospitalizations for ACSCs significant differences among continuity groups existed only for the 12+ age group with hospitalizations increasing slightly with increasing continuity level. As age increased the high continuity group tended to have lowest number of hospitalizations although differences in hospitalizations between continuity groups were not statistically-significant. In the high-continuity group, there was a trend towards the low continuity group having the highest number of hospital separations for ACSCs.

Tables 4.29 and 4.30 present specialist and hospital utilization data by continuity of care level for a second set of age groups. For total and ambulatory specialist contacts, there were statistically-significant differences across continuity levels for the lower three age groups only (12-19, 20-44, and 45-64). The medium continuity group tended to have the highest number of total specialist and ambulatory specialist contacts. The high

Table 4.28: Inpatient Hospital Utilization by Continuity Group by Age Group (MCP Sample) Continuity (1999-2000) and Outcomes (2001-2002)

Type of Hospitalization	Age Grp (Yrs)	Continuity of Care Level				p-value
		Low (<0.5)	Medium (0.5-0.74)	High (≥0.75)	Overall	
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Total Hospital Separations[1]	12+	0.23 (0.80)	0.28 (0.87)	0.29 (0.80)	0.27 (0.81)	<0.001*
	55+	0.45 (1.10)	0.51 (1.22)	0.46 (1.07)	0.47 (1.10)	0.241
	65+	0.54 (1.21)	0.64 (1.32)	0.57 (1.18)	0.58 (1.21)	0.122
	75+	0.61 (1.34)	0.69 (1.28)	0.65 (1.28)	0.65 (1.29)	0.077
Hospitalizations for ACSCs[1]	12+	0.04 (0.32)	0.06 (0.40)	0.07 (0.43)	0.06 (0.40)	<0.001*
	55+	0.17 (0.67)	0.18 (0.72)	0.15 (0.64)	0.16 (0.66)	0.258
	65+	0.25 (0.81)	0.26 (0.89)	0.22 (0.76)	0.23 (0.79)	0.123
	75+	0.34 (0.98)	0.31 (0.84)	0.26 (0.82)	0.28 (0.85)	0.140

[1]Number of hospital separations per person over 2-year period * indicates p < 0.05

Table 4.29: Specialist Utilization by Continuity Group by Age Group (MCP Sample) Continuity and Outcomes over same 4-year period (1999-2002)

Type of Physician	Age Grp (Yrs)	Continuity of Care Level				p-value
		Low (<0.5)	Medium (0.5-0.74)	High (≥0.75)	Overall	
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Total Specialist Contacts[1]	12-19	3.78 (8.70)	4.24 (8.10)	3.48 (6.19)	3.76 (7.70)	0.018*
	20-44	6.11 (11.18)	7.10 (11.99)	6.22 (10.17)	6.38 (10.89)	<0.001*
	45-64	10.30 (14.58)	11.50 (17.39)	10.75 (17.16)	10.81 (16.76)	<0.001*
	65-74	14.17 (19.25)	18.28 (33.97)	14.90 (24.58)	5.36 (25.77)	0.138
	75+	11.32 (17.65)	12.60 (17.59)	12.62 (21.39)	12.40 (20.20)	0.123
Ambula-tory Specialist Contacts[1]	12-19	1.23 (2.67)	1.32 (2.54)	1.17 (2.74)	1.23 (2.67)	0.015*
	20-44	2.02 (4.11)	2.42 (4.79)	2.02 (3.97)	2.10 (4.20)	<0.001*
	45-64	2.73 (4.35)	3.16 (4.99)	2.83 (4.73)	2.87 (4.71)	<0.001*
	65-74	3.37 (4.51)	3.80 (5.00)	3.48 (5.21)	3.51 (5.08)	0.100
	75+	2.50 (4.91)	2.88 (5.76)	2.56 (3.85)	2.60 (4.42)	0.215

[1]Number of contacts per person over 2-year period * indicates p < 0.05

Table 4.30: Inpatient Hospital Utilization by Continuity Group by Age Group (MCP Sample) Continuity and Outcomes over same 4-year period (1999-2002)

Type of Hospitalization	Age Group (Years)	Continuity of Care Level				p-value
		Low (<0.5)	Medium (0.5-0.74)	High (≥0.75)	Overall	
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Total Hospital Separations[1]	12-19	0.13 (0.52)	0.18 (0.81)	0.13 (0.48)	0.14 (0.58)	0.357
	20-44	0.18 (0.75)	0.21 (0.67)	0.18 (0.55)	0.19 (0.64)	0.102
	45-64	0.24 (0.77)	0.25 (0.82)	0.25 (0.75)	0.25 (0.77)	0.175
	65-74	0.49 (1.08)	0.61 (1.36)	0.51 (1.09)	0.52 (1.14)	0.739
	75+	0.61 (1.34)	0.69 (1.28)	0.65 (1.28)	0.65 (1.29)	0.077
Hospitalizations for ACSCs[1]	12-19	0.01 (0.13)	0.01 (0.10)	0.01 (0.12)	0.01 (0.12)	0.865
	20-44	0.01 (0.10)	0.01 (0.09)	0.01 (0.15)	0.01 (0.13)	0.675
	45-64	0.03 (0.27)	0.05 (0.34)	0.05 (0.35)	0.05 (0.33)	0.038
	65-74	0.17 (0.60)	0.22 (0.92)	0.18 (0.72)	0.19 (0.74)	0.734
	75+	0.34 (0.99)	0.31 (0.84)	0.26 (0.82)	0.28 (0.85)	0.140

[1]Number of hospital separations per person over 2-year period

continuity group tended to have the lowest number of total specialist contacts while the low continuity group tended to have the highest number of ambulatory specialist contacts, but this was not always the case.

There were no significant differences in total number of hospital separations across continuity groups but there was a trend towards a higher number of hospital separations in the medium-continuity group. There was a statistically-significant difference in hospitalizations for ACSCs in the 45-64 age group only, with the number of hospitalizations for ACSCs slightly lower in the low-continuity group.

4.3.3 Multivariate Analysis

Backward conditional regression analysis was used to investigate the relationship of continuity of care and co-variates with each of the heath care services utilization outcomes for all ages in the sample (i.e. 12+ age group). Model fit characteristics were similar to those in Phase I. Thus, as in Phase I, the Poisson model was used for the regression models involving hospital separations and hospital separations for ACSCs and the negative binomial model for the regression models involving the two specialist measures. As is the previous four-year analysis, for the model for hospital separations for ACSCs, the chronic conditions co-variate was removed from the model given that all of the ACSCs conditions used in the study were chronic conditions. Results are presented in terms of rate ratios, which are equal to the anti-log of the regression co-efficient.

Table 4.31 presents the results of the final step of a backward conditional regression involving factors associated with number of hospital separations for all age in the sample (i.e. 12+ age group). Medium continuity was associated with a significant 5.3 % increase in hospital separations relative to high continuity while there was no difference in hospital separations between the low and high continuity groups. Other factors associated with number of hospital separations included age, number of chronic illnesses, income quintile, and number of FP visits.

Table 4.32 shows results of the final step of a backward conditional regression for factors associated with hospital separations for ACSCs. There were no significant differences in hospitalizations for ASCSs between continuity groups for the whole sample (ages 12+). Factors associated with number of hospitalizations for ACSCs were

Table 4.31: Factors Associated with Inpatient Hospitalizations (Poisson Regression) Continuity (1999-2000) and Outcomes (2001-2002); Ages 12+ (N=42,602)

Characteristic	Adjusted Analysis Rate Ratio (95 % C.I.)
Continuity of FP Care	
High (≥ 0.75)	**1.00**
Medium (>0.5 but < 0.75)	1.053* (1.003-1.106)
Low (< 0.5)	1.001 (0.953-1.051)
Age	1.014* (1.013-1.016)
Gender	
Female	1.034 (0.995-1.075)
Number of Chronic Conditions	
0	**1.00**
1	1.038 (0.965-1.116)
2+	2.104* (1.964-2.253)
Income	
Q1	**1.00**
Q2	1.366* (1.269-1.470)
Q3	1.304* (1.215-1.400)
Q4	1.208* (1.133-1.289)
Q5	1.141* (1.072-1.215)
Rural/Urban	
Rural	**1.000**
Urban	0.976 (0.933-1.022)
Number of FP Visits	
High	**1.00**
Medium	0.745* (0.709-0.784)
Low	0.659* (0.626-0.694)

* indicates significant difference from reference group

Table 4.32: Factors Associated with Inpatient Hospitalizations for ACSCs (Poisson Regression) Continuity (1999-2000) and Outcomes (2001-2002); Ages 12+ (N=42,602)

Characteristic	Adjusted Analysis Rate Ratio (95 % C.I.)
Continuity of FP Care	
High (≥ 0.75)	**1.00**
Medium (>0.5 but < 0.75)	1.103 (0.993-1.131)
Low (< 0.5)	1.011 (0.904-1.058)
Age	1.062* (1.059-1.064)
Gender	
Female	0.681* (0.628-0.739)
Income	
Q1	**1.00**
Q2	1.394* (1.295-1.500)
Q3	1.333* (1.247-1.436)
Q4	1.229* (1.152-1.310)
Q5	1.145* (1.076-1.219)
Rural/Urban	
Rural	**1.00**
Urban	0.804* (0.729-0.888)
Number of FP Visits	
High	**1.00**
Medium	0.490* (0.436-0.550)
Low	0.393* (0.348-0.443)

* indicates significant difference from reference group

age, gender, income quintile, and number of FP visits.

Table 4.33 presents the results of the final step of a backward condition regression involving factors associated with number of specialist contacts. Medium-continuity was associated with a 5.6 % increase in specialist contacts relative to high-continuity while there was no difference in specialist contacts between the low- and high-continuity

Table 4.33: Factors Associated with Specialists Visits (Negative Binomial Regression) Continuity (1999-2000) and Outcomes (2001-2002); Ages 12+ (N=42,602)

Characteristic	Adjusted Analysis Rate Ratio (95 % C.I.)
Continuity of FP Care	
High (≥ 0.75)	**1.00**
Medium (>0.5 but < 0.75)	1.056* (1.020-1.092)
Low (< 0.5)	0.982 (0.951-1.015)
Age	1.013* (1.012-1.014)
Gender	
Female	1.118* (1.088-1.148)
Number of Chronic Conditions	
0	**1.00**
1	1.341* (1.293-1.391)
2+	2.069* (1.990-2.151)
Income	
Q1	**1.00**
Q2	0.945* (0.899-0.993)
Q3	0.945* (0.901-0.991)
Q4	0.993 (0.952-1.035)
Q5	0.972 (0.935-1.010)
Rural/Urban	
Rural	**1.000**
Urban	1.220* (1.181-1.260)
Number of FP Visits	
High	**1.00**
Medium	0.772 (0.746-0.799)
Low	0.635 (0.614-0.656)

* indicates significant difference from reference group

groups. Other factors associated with number of specialist contacts included age, gender, number of chronic illnesses, rural/urban status, income quintile, and number of FP visits.

Table 4.34 presents the results of the final step of a backward conditional regression involving factors associated with number of ambulatory specialist contacts. Medium continuity was associated with a 7.9 % increase in ambulatory specialist contacts relative to high continuity while there was no difference in ambulatory specialist contacts between the low and high continuity groups. Other factors associated with number of ambulatory specialist contacts included age, gender, number of chronic illnesses, rural-urban status, income quintile, and number of FP visits.

Tables for similar regression analyses for age groups 55+, 65+ and 75+ as well as for the 12-19, 20-44, 45-64, and 65-74 age groups are presented in Appendix N.

Table 4.35 presents a summary of the rate ratios for the continuity of care variable in the regression analysis for each health outcome by age group (12+, 55+, 65+, and 75+). In the 12+ sample, as indicated previously, being in the medium-continuity group was associated with a 5.3% increase in hospital separations relative to the high continuity group while there was no significant difference in hospital separations between the low and high continuity groups. The magnitude of the increase becomes slightly higher as we move from the 12+ age group to the 55+ and 65+ age groups but there was no significant difference between the low- and high-continuity groups for any age group. For the 75+ age group neither the medium- or low-continuity group differed from the high-continuity group (Table 4.35A). For hospitalizations for ACSCs, we see a different pattern, similar to that seen in the cross-sectional analysis where the magnitude of difference in hospitalizations between continuity groups increases with age. The medium continuity

Table 4.34: Factors Associated with Ambulatory Specialist Visits (Negative Binomial Regression) Continuity (1999-2000) and Outcomes (2001-2002); Ages 12+ (N=42,602)

Characteristic	Adjusted Analysis Rate Ratio (95 % C.I.)
Continuity of FP Care	
High (≥ 0.75)	**1.00**
Medium (>0.5 but < 0.75)	1.079* (1.036-1.124)
Low (< 0.5)	0.988 (0.951-1.027)
Age	1.006* (1.005-1.007)
Gender	
Female	1.067* (1.033-1.0102)
Number of Chronic Conditions	
0	**1.00**
1	1.252* (1.197-1.309)
2+	1.813* (1.730-1.900)
Income	
Q1	**1.00**
Q2	0.867* (0.816-0.920)
Q3	0.793* (0.749-0.839)
Q4	0.904* (0.860-0.950)
Q5	0.884* (0.844-0.925)
Rural/Urban	
Rural	**1.000**
Urban	1.481* (1.425-1.540)
Number of FP Visits	
High	**1.00**
Medium	0.726* (0.698-0.756)
Low	0.568* (0.546-0.591)

* indicates significant difference from reference group

Table 4.35 Summary of Log-Linear Regressions - MCP Sample (N=42,602) (Continuity measured from 1999-2000 and HSU Outcomes measured from 2001-2002) (First Set of Age Groups)

Table 4.35A: Continuity (1999-2000) and Inpatient Hospitalization (2001-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	1.00	1.053* (1.003-1.106)	1.000 (0.952-1.051)
55+	1.00	1.073* (1.001-1.149)	0.982 (0.911-1.059)
65+	1.00	1.108* (1.021-1.202)	0.970 (0.886-1.062)
75+	1.00	1.008 (0.895-1.136)	0.946 (0.833-1.074)

* indicates significant difference from reference group

Table 4.35B: Continuity (1999-2000) and Inpatient Hospitalization for Ambulatory Care Sensitive Conditions (2001-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	1.00	1.103 (0.993-1.131)	1.011 (0.904-1.058)
55+	1.00	1.184* (1.054-1.331)	1.097 (0.967-1.245)
65+	1.00	1.283* (1.129-1.458)	1.177* (1.025-1.353)
75+	1.00	1.258* (1.053-1.503)	1.350* (1.127-1.618)

* indicates significant difference from reference group

Table 4.35C: Continuity (1999-2000) and Specialist Visits (2001-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	1.00	1.056* (1.020-1.092)	0.982 (0.951-1.015)
55+	1.00	1.076* (1.011-1.146)	0.978 (0.917-1.043)
65+	1.00	1.087 (0.996-1.186)	0.978 (0.893-1.071)
75+	1.00	0.985 (0.855-1.134)	0.930 (0.806-1.074)

* indicates significant difference from reference group

Table 4.35D: Continuity (1999-2000) and Ambulatory Specialist Visits (2001-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	1.00	1.079* (1.036-1.124)	0.988 (0.951-1.027)
55+	1.00	1.061 (0.991-1.135)	1.022 (0.953-1.096)
65+	1.00	1.076 (0.985-1.177)	1.067 (0.972-1.171)
75+	1.00	1.087 (0.940-1.257)	1.067 (0.919-1.238)

* indicates significant difference from reference group

group has the greatest number of hospitalizations in the 55+ and 65+ with a shift to where number of hospitalizations for ACSCs increases with decreasing continuity occurring at the 75+age group (Table 4.35B).

For specialist contacts, the only significant change in number of specialist contacts seen was a slight increase for the medium-continuity group relative to the high-continuity group for the 12+ and 55+ age groups only (Table 4.35C). For ambulatory specialist contacts the only change seen is a slight increase for the medium-continuity group relative to the high-continuity group for the 12+ age group only (Table 4.35D). Although not always statistically significant, the estimate for medium continuity tended to be higher than that for low continuity.

Table 4.36 presents a summary of the rate ratios for the continuity of care variable in the regression analysis for each health outcome by a second set of age groups (12+ (all ages), 12-19, 20-44, 45-64, 65-74, and 75+). For hospital separations significant increases were seen for medium continuity group in the 12+ age (5.3%) and 65-74 (20.6%) age group (Table 4.36A) relative to the high continuity group. No significant differences were seen for the low continuity group (Table 4.36A).

For hospitalizations for ACSCs significant increases were seen for the medium continuity group relative to the high continuity group for the 65-74 age group (33.5%) and, as stated above, at the 75+ age group increases were seen for the medium (25.5%) and high (35.0%) continuity groups (Table 4.36B).

For specialist contacts, the only significance differences seen was a 19.7% increase for the medium-continuity group relative to the high-continuity group for the

Table 4.36 Summary of Log-Linear Regressions - MCP Sample (N=42,602) (Continuity measured from 1999-2000 and HSU Outcomes measured from 2001-2002) (Second Set of Age Groups)

Table 4.36A: Continuity (1999-2000) and Inpatient Hospitalization (2001-2002) (Poisson Regression)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	**1.00**	1.053* (1.003-1.106)	1.000 (0.952-1.051)
12-19	**1.00**	1.202 (0.972-1.487)	0.900 (0.742-1.093)
20-44	**1.00**	0.999 (0.913-1.093)	0.915 (0.840-0.999)
45-64	**1.00**	0.971 (0.885-1.066)	1.010 (0.920-1.109)
65-74	**1.00**	1.206* (1.077-1.350)	0.995 (0.874-1.134)
75+	**1.00**	1.008 (0.895-1.136)	0.946 (0.833-1.074)

* indicates significant difference from reference group

Table 4.36B: Continuity (1999-2000) and Inpatient Hospitalization for ACSCs (2001-2002) (Poisson Regression)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	**1.00**	1.103 (0.993-1.131)	1.011 (0.904-1.058)
12-19	**1.00**	0.703 (0.268-1.843)	1.152 (0.569-2.333)
20-44	**1.00**	0.697 (0.446-1.092)	0.920 (0.629-1.346)
45-64	**1.00**	0.722 (0.568-1.067)	0.919 (0.745-1.132)
65-74	**1.00**	1.335* (1.100-1.619)	1.051 (0.838 –1.317)
75+	**1.00**	1.258* (1.053-1.503)	1.350* (1.127-1.618)

* indicates significant difference from reference group

Table 4.36C: Continuity (1999-2000) and Specialist Visits (2001-2002) (Negative Binomial Regression)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	**1.00**	1.056* (1.020-1.092)	0.982 (0.951-1.015)
12-19	**1.00**	1.096 (0.960-1.250)	1.014 (0.908-1.133)
20-44	**1.00**	1.074 (1.018-1.133)	1.023 (0.973-1.073)
45-64	**1.00**	1.022 (0.968-1.079)	0.987 (0.935 (1.043)
65-74	**1.00**	1.197* (1.072-1.336)	1.013 (0.902-1.139)
75+	**1.00**	0.985 (0.855-1.134)	0.930 (0.806-1.074)

* indicates significant difference from reference group

Table 4.36D: Continuity (1999-2000) and Ambulatory Specialist Visits (2001-2002) (Negative Binomial Regression)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	**1.00**	1.079* (1.036-1.124)	0.988 (0.951-1.027)
12-19	**1.00**	0.990 (0.843-1.163)	0.958 (0.838-1.097)
20-44	**1.00**	1.099* (1.027-1.176)	1.010 (0.948-1.075)
45-64	**1.00**	1.090* (1.020-1.163)	1.008 (0.944-1.077)
65-74	**1.00**	1.090 (0.975-1.218)	1.064 (0.944-1.198)
75+	**1.00**	1.087 (0.940-1.257)	1.067 (0.919-1.238)

* indicates significant difference from reference group

65-74 age group (Table 4.36C). For ambulatory specialist visits, significant increases of 9% were seen for the medium continuity group for the 20-44 and 45-64 age groups (Tables 4.36D).

4.4 Cost Outcome Analyses

4.4.1 Cross-sectional MCP Analysis (Phase II) (Continuity and Outcomes measured from 1999-2002)

4.4.1.1 Descriptive Statistics of Cost Outcomes

Table 4.37 presents descriptive statistics for per-patient cost measures for the overall study sample for the cross-sectional MCP analysis. Home and office fee-for-service FP visits had a total cost of $20,973,003 and a mean per-person cost of $415 over four years. Total specialist costs totalled $36,655,377 with a mean of $726 per person over four years. Total physician costs totalled $57,628,380 with a mean cost of $1141 per person over four years. Hospital costs totalled in excess of $180,000,000 with a mean cost of $3656 per person over four years. All four cost measures were positively-skewed and highly variable as indicated by high skewness and variance values. Hospital costs

Table 4.37: Descriptive Statistics for Per-Person Health Care Services Costs Outcomes for 4-year Period (1999-2002) (MCP Sample) (Continuity and Costs Outcomes Measured over same 4-year period) (N=50,499)

Measure	Mean (SD) (per Person)	Median	Minimum	Maximum
FP Billings (H&O)	415 (434)	295.09	36.0	13,862
Specialists Billings	726 (1396)	286.08	0.00	36,263
Total Physician Billings	1141 (1577)	663.30	36.0	37,112
Inpatient Hospital Costs	3656 (13,789)	0.00	0.00	714,098

were the most variable and the most skewed.

Table 4.38 presents per-person physician cost outcomes by continuity of care level for the following age groups: 12+ (all ages), 55+, 65+, and 75+. For FP billings, significant differences between continuity groups existed for all age groups except the 75+ group. FP costs tended to increase with increasing continuity. For specialist costs there were significant differences between continuity groups for all age groups except the 65+ group. For the 12+ age group specialist costs tended to increase with increasing continuity while for the 55+ and 65+ age groups the medium continuity group tended to have the highest costs. For the 75+ age group the costs tended to increase with decreasing continuity. For total physician costs, there were significant between-group

Table 4.38: Physician Costs by Continuity Group by Age Group (MCP Sample) (Continuity and Outcomes measured from 1999-2002) (First Set of Age Groups)

Type of Physician Cost	Age Group (Years)	Continuity of Care Level				p-value
		Low (<0.5)	Medium (0.5-0.74)	High (≥0.75)	Overall	
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
FP Cost[1]	12+	372 (391)	425 (408)	435 (464)	415 (434)	<0.001*
	55+	566 (543)	584 (522)	590 (585)	584 (566)	0.006*
	65+	644 (611)	664 (595)	678 (641)	669 (627)	0.033*
	75+	733 (720)	734 (676)	775 (751)	759 (731)	0.120
Specialists Cost[1]	12+	618 (1268)	756 (1419)	772 (1451)	725 (1396)	<0.001*
	55+	1236 (1994)	1343 (2187)	1177 (1850)	1219 (1945)	0.007*
	65+	1406 (2306)	1435 (2268)	1283 (1979)	1334 (2098)	0.111
	75+	1339 (1713)	1268 (1742)	1158 (1682)	1215 (1701)	0.023*
Total Physician Cost[1]	12+	991 (1439)	1181 (1588)	1207 (168)	1141 (1577)	<0.001*
	55+	1802 (2190)	1927 (2350)	1768 (2046)	1804 (2134)	0.032*
	65+	2050 (2490)	2099 (2436)	1961 (2167)	2003 (2282)	0.464
	75+	2073 (1972)	2003 (1945)	1933 (1917)	1974 (1933)	0.429

[1]Cost per person over 4-year period   * indicates $p < 0.05$

differences for the 12+ and 55+ age groups. In the 12+ group cost increased with increasing continuity level while in the 55+ and 65+ age groups cost tended to be highest in the medium continuity group, although differences in the 65+ group did not reach statistical significance. In the 75+ group there was a trend towards increasing cost with decreasing continuity level although, again, differences were not statistically significant.

As seen in Table 4.39, significant between-group differences in hospital cost existed for only the 12+ and 75+ age groups. For the 12+ age group, hospital cost tended to increase with increasing continuity. For the 55+ age group, costs were highest for the medium-continuity group and for the two oldest age groups cost tended to increase with decreasing continuity, but was significant only for the 75+ age group where there was almost a $900 per person cost increase between the low and medium continuity groups

Table 4.39: Hospital Costs by Continuity Group by Age Group (MCP Sample) (Continuity and Outcomes measured from 1999-2002) (First Set of Age Groups)

	Age Grp (Yrs)	Continuity of Care Level				p-value
		Low (<0.5)	Medium (0.5-0.74)	High (≥ 0.75)	Overall	
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Hospital Cost[1]	12+	2961 (12,478)	3842 (15,013)	3960 (13,934)	3656 (13,790)	<0.001*
	55+	9131 (22,978)	9328 (24,620)	7838 (20,448)	8356 (21,775)	0.275
	65+	12,445 (26,210)	12,392 (28,768)	10,506 (24,056)	11,214 (25,409	0.123
	75+	15,621 (25,956)	14,769 (28,479)	12,231 (22,714)	13,393 (24,618)	<0.007*

[1]Cost per person over 4-year period * indicates $p < 0.05$

and over a $3000 increase between the low and high continuity groups.

Table 4.40 presents per-person physician cost outcomes by continuity of care level for a second set of age groups (i.e. ages 12-19, 20-44, 45-64, 65-74, and 75+). For FP costs significant differences existed between continuity groups for the three youngest age groups. For these three age groups the medium continuity group tended to have the highest cost. For the 65-74 age group, the medium and high continuity groups had similar costs values, which tended to be slightly higher than seen in the low continuity group. For the 75+ age group the high continuity tended to have the highest cost. The low continuity group tended to have the lowest cost except in the 12-19 age group. For specialist costs, significant between-group differences were seen for all age groups except the 65-74 group. For the 12-19 age group, the medium- and high-continuity groups had similar costs, which were higher than that of the low-continuity group. For the three middle age groups the medium-continuity group tended to have the highest cost. Cost was lowest in the low continuity group for the 20-44 and 45-64 age groups and tended to be lowest in the high continuity group for the 65-74 age group. In the 75+ group, the cost

Table 4.40: Physician Costs by Continuity Group by Age Group (MCP Sample) (Continuity and Outcomes measured from 1999-2002) (Second Set of Age Groups)

Type of Physician Cost	Age Group (Years)	Continuity of Care Level				p-value
		Low (<0.5)	Medium (0.5-0.74)	High (≥ 0.75)	Overall	
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
FP Cost[1]	12-19	264 (232)	289 (248)	245 (228)	263 (235)	<0.001*
	20-44	337 (334)	371 (349)	343 (354)	347 (347)	<0.001*
	45-64	409 (417)	447 (385)	437 (435)	433 (422)	<0.001*
	65-74	561 (487)	601 (523)	603 (536)	595 (526)	0.091
	75+	734 (720)	734 (677)	776 (752)	759 (731)	0.120
Specialist Cost[1]	12-19	288 (602)	312 (588)	311 (688)	301 (628)	0.009*
	20-44	477 (941)	539 (933)	499 (983)	501 (959)	<0.001*
	45-64	818 (1410)	928 (1584)	873 (1538)	873 (1522)	<0.001*
	65-74	1443 (2732)	1590 (2659)	1368 (2139)	1421 (2352)	0.574
	75+	1339 (1713)	1269 (1742)	1157 (1682)	1215 (1702)	0.023*
Total Physician Cost[1]	12-19	552 (710)	602 (735)	555 (773)	564 (736)	<0.001*
	20-44	814 (1091)	909 (1085)	842 (1126)	848 (1106)	<0.001*
	45-64	1227 (1587)	1374 (1738)	1310 (1718)	1306 (1697)	<0.001*
	65-74	2004 (2877)	2190 (2823)	1971 (2307)	2016 (2514)	0.325
	75+	2073 (1972)	2003 (1946)	1934 (1917)	1975 (1934)	0.429

[1]Cost per person over 4-year period * indicates $p < 0.05$

increased with decreasing continuity. For total physician costs, there were significant between-group differences for the three younger age groups. The medium-continuity group tended to have the highest cost except in the 75+ age group where the low–continuity group tended to have the highest cost. The high-continuity group tended to have the lowest cost for the two older age groups while the low-continuity group tended to have the lowest cost for the 20-44 and 45-64 age groups. For the 12-19 age group, the low- and high-continuity groups had similar cost values.

Table 4.41 shows that there were significant differences in hospital costs between continuity groups for all age groups except the 65-74 group. For the first four age groups, the medium-continuity group tended to have the highest associated cost while for

Table 4.41: Inpatient Hospital Costs by Continuity Group by Age Group (MCP Sample) Continuity and Outcomes (1999-2002) (Second Set of Age Groups)

	Age Grp (Yrs)	Continuity of Care Level				p-value
		Low (<0.5)	Medium (0.5-0.74)	High (≥ 0.75)	Overall	
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Hospital Cost[1]	12-19	1179 (7631)	1322 (7287)	1172 (4867)	1208 (6773)	0.049*
	20-44	1489 (6406)	1979 (9341)	1707 (6492)	1697 (7199)	0.001*
	45-64	3208 (13,752)	3611 (13,299)	3348 (12,248)	3373 (12,790)	0.042*
	65-74	9444 (26,253)	10,546 (29,705)	9190 (25,262)	9477 (26,282)	0.521
	75+	15,621 (25,956)	14,769 (28,479)	12,231 (22,714)	13,392 (24,618)	0.007*

[1]Cost per person over 4-year period * indicates $p < 0.05$

the 75+ group cost increased with decreasing continuity level. The continuity level having the lowest hospital costs showed a similar pattern to that of the total physician costs.

4.4.1.2 Multivariate Analysis of Cost Outcomes

Due to skewed distributions, cost variables were log-transformed in an attempt to attain normality before tobit analysis was carried out. The distribution for physician cost outcomes became near normal except for that of the specialist cost outcome, which showed a large spike at the far left of the distribution representing those with zero (0) cost (i.e. no specialist visits) (~ 28% of the sample). Thus, the tobit models were set to censor cases with zero cost. Note that for FP and total physician costs it was not possible to have zero (0) cost because patients with less than three FP visits were excluded from the analysis. Thus, for these groups, near normal distributions were attained after log transformation. In addition, there were no censored cases and thus the tobit regressions were essentially ordinary least squares (OLS) regressions for these two outcomes. The beta-coefficients from the regressions were exponentiated and are presented in the tables. Tables 4.42 to 4.45 present the results of the final steps of tobit analysis showing exponentiated beta coefficients for factors associated with physician cost for the cross-sectional MCP sample (age 12+). Table 4.42 presents factors associated with FP cost. Medium-continuity was associated with a 2.3 % increase in FP cost relative to high continuity, but there was no corresponding increase for low continuity. Other factors associated with FP costs included age, gender, number chronic illnesses, income quintile and number of FP visits.

Table 4.43 shows factors associated with specialist costs. Medium-continuity was associated with a 7.2% increase in specialist cost relative to high continuity while low-continuity was associated with a small reduction in specialist cost. Other factors associated with specialist costs included age, gender, number of chronic illnesses and rural/urban status. Regression estimates for total physician costs showed a similar pattern to that of specialist cost except that income was not a statistically significant predictor of total physician cost (Table 4.44).

For the hospital cost analysis, after log transformation, the distribution of the hospital costs variable had a large spike at the left representing patients with zero hospital cost (approximately 79% of the sample). Censoring of these cases in the tobit model resulted in a large reduction in sample size and very wide confidence intervals for the regression estimates. Thus, it was decided to use ordinary least squares (OLS) regression

Table 4.42: Factors Associated with FP Cost (MCP Sample) Continuity and Outcomes (1999-2002); Ages 12+ (N=50,499)

Characteristic	Adjusted Analysis Rate Ratio (95 % C.I.)
Continuity of FP Care	
High (≥ 0.75)	**1.00**
Medium (>0.5 but < 0.75)	1.023* (1.012-1.033)
Low (< 0.5)	1.001 (0.992-1.011)
Age	1.003* (1.003-1.003)
Gender	
Female	1.107* (1.098-1.159)
Number of Chronic Conditions	
0	**1.00**
1	1.053* (1.042-1.064)
2+	1.201* (1.187-1.215)
Income	
Q1	**1.00**
Q2	1.029* (1.023-1.044)
Q3	1.063* (1.049-1.079)
Q4	1.014* (1.001-1.027)
Q5	1.012* (1.001-1.024)
Rural/Urban	
Rural	**1.000**
Urban	1.001 (0.991-1.011)
Number of FP Visits	
High	**1.00**
Medium	0.473* (0.468-0.478)
Low	0.207* (0.205-0.209)

* indicates significant difference from reference group

Table 4.43: Factors Associated with Specialist Cost (MCP Sample) Continuity and Outcomes (1999-2002); Ages 12+ (N=50,499)

Characteristic	Adjusted Analysis Rate Ratio (95 % C.I.)
Continuity of FP Care	
High (≥ 0.75)	**1.00**
Medium (> 0.5 but < 0.75)	1.072* (1.019-1.127)
Low (< 0.5)	0.950* (0.906-0.995)
Age	1.018* (1.017-1.020)
Gender	
Female	1.300* (1.248-1.353)
Number of Chronic Conditions	
0	**1.00**
1	1.552* (1.473-1.634)
2+	2.648* (2.497-2.808)
Income	
Q1	**1.00**
Q2	0.885* (0.821-0.953)
Q3	0.887* (0.825-0.952)
Q4	0.862* (0.810-0.917)
Q5	0.888* (0.838-0.941)
Rural/Urban	
Rural	**1.00**
Urban	1.234* (1.176-1.295)
Number of FP Visits	
High	**1.00**
Medium	0.542* (0.515-0.569)
Low	0.202* (0.191-0.213)

* indicates significant difference from reference group

Table 4.44: Factors Associated with Total Physician Cost (MCP Sample) Continuity and Outcomes (1999-2002); Ages 12+ (N=50,499)

Characteristic	Adjusted Analysis Rate Ratio (95 % C.I.)
Continuity of FP Care	
High (≥ 0.75)	**1.00**
Medium (> 0.5 but < 0.75)	1.030* (1.011-1.049)
Low (< 0.5)	0.979* (0.962-0.996)
Age	1.010* (1.009-1.010)
Gender	
Female	1.132* (1.116-1.149)
Number of Chronic Conditions	
0	**1.00**
1	1.145* (1.123-1.166)
2+	1.519* (1.487-1.552)
Income	
Q1	**1.00**
Q2	0.989 (0.962-1.016)
Q3	0.985 (0.960-1.011)
Q4	0.964 (0.942-0.986)
Q5	0.967 (0.947-0.988)
Rural/Urban	
Rural	**1.000**
Urban	1.107* (1.087-1.126)
Number of FP Visits	
High	**1.00**
Medium	0.541* (0.531-0.551)
Low	0.261* (0.256-0.267)

* indicates significant difference from reference group

for the hospital cost analysis. Given that when the zero- cost cases were included in the analysis the normality assumption of OLS regression was violated, zero-cost cases were excluded from the OLS analysis regression of hospital data. Confidence intervals for the OLS analysis were somewhat wide but not to the great extent of those seen when tobit was used to model hospital cost.

Table 4.45 presents the results of the final step of an OLS regression for hospital cost for the cross-sectional MCP sample omitting cases with zero hospital cost. There was no association of continuity with hospital cost. Factors associated with hospital cost included age, gender, rural/urban status, and number of FP visits.

Tables for similar regression analyses for age groups 55+, 65+, and 75+ as well as for the 12-19, 20-44, 45-64, and 65-74 age groups are presented in Appendix N.

Table 4.46 presents a summary of exponentiated beta coefficients for the continuity of care predictor for regression analysis for each cost outcome for the cross-sectional MCP sample by age group. For FP costs the only significant association was the previously-seen small reduction in cost for the medium continuity group relative to high continuity for the full sample (age 12+) (Table 4.46A). With respect to specialist cost, as previously mentioned for the 12+ age group, medium-continuity was associated with an increase in cost relative to the high-continuity group while low-continuity was associated with small reduction in cost. For the 55+ age group there was an increase in specialist cost for both the low and medium continuity group relative to high continuity with the magnitude of the increase being larger for the low continuity group. Results for the 65+ and 75+ age group were similar except that the increase for the medium-

Table 4.45: Factors Associated with Inpatient Hospital Cost (MCP Sample) Continuity and Outcomes (1999-2002); Ages 12+ (N=50,499)

Characteristic	Adjusted Analysis Rate Ratio (95 % C.I.)
Continuity of FP Care	
High (≥ 0.75)	**1.00**
Medium (>0.5 but < 0.75)	1.059 (0.991-1.131)
Low (< 0.5)	1.033 (0.970-1.100)
Age	1.016* (1.015-1.018)
Gender	
Female	0.890* (0.843-0.940)
Number of Chronic Conditions	
0	**1.00**
1	0.999 (0.921-1.084)
2+	1.273* (1.172-1.382)
Income	
Q1	**1.00**
Q2	1.033 (0.936-1.141)
Q3	1.033 (0.936-1.113)
Q4	1.013 (0.922-1.108)
Q5	1.022 (0.941-1.108)
Rural/Urban	
Rural	**1.000**
Urban	1.090* (1.024-1.161)
Number of FP Visits	
High	**1.00**
Medium	0.876* (0.823-0.932)
Low	0.942 (0.878-1.011)

* indicates significant difference from reference group

Table 4.46 Summary of Tobit/OLS Regressions - MCP Sample (Continuity and outcomes measured from 1999-2002) (N=50,499)

Table 4.46A: Continuity and FP Cost (1999-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	1.00	1.023* (1.012-1.033)	1.001 (0.992-1.011)
55+	1.00	1.001 (0.980-1.022)	0.982 (0.961-1.005)
65+	1.00	0.985 (0.956-1.017)	0.976 (0.947-1.008)
75+	1.00	0.958 (0.909-1.010)	0.958 (0.909-1.009)

* indicates significant difference from reference group

Table 4.46B: Continuity and Specialist Cost (1999-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	1.00	1.072* (1.019-1.127)	0.950* (0.906-0.995)
55+	1.00	1.119* (1.024-1.222)	1.163* (1.063-1.273)
65+	1.00	1.104 (0.981-1.242)	1.229* (1.091-1.384)
75+	1.00	1.094 (0.915-1.309)	1.293* (1.081-1.546)

* indicates significant difference from reference group

Table 4.46C: Continuity and Total Physician Cost (1999-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	1.00	1.030* (1.011-1.049)	0.979 (0.962-0.996)
55+	1.00	1.034 (0.996-1.074)	1.019 (0.981-1.059)
65+	1.00	1.023 (0.972-1.076)	1.044 (0.993-1.098)
75+	1.00	1.006 (0.936-1.083)	1.077* (1.002-1.158)

* indicates significant difference from reference group

Table 4.46D: Continuity and Inpatient Hospital Cost (1999-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	1.00	1.059 (0.991-1.131)	1.033 (0.970-1.100)
55+	1.00	1.117* (1.009-1.236)	1.066 (0.963-1.180)
65+	1.00	1.102 (0.967-1.254)	1.071 (0.943-1.217)
75+	1.00	1.195* (1.005-1.421)	1.231* (1.041-1.454)

* indicates significant difference from reference group

continuity did not reach statistical significance. The magnitude of the increase in specialist cost for the low continuity group increased consistently with age. For total physician cost, the only statistically significant results seen were small increases in cost in the whole sample (age 12+) for the medium continuity group relative to the high-continuity group, a slight reduction in cost for the low continuity group, as well as an increase in cost for low continuity relative to high continuity in the 75+ age group. With respect to hospital costs, there was a significant increase in cost for medium continuity relative to high continuity in the 55+ age group and a significant increase in cost for both low and medium continuity groups relative to high continuity in the 75+ age group with the magnitude of the increase being slightly higher for the low continuity group.

Table 4.47 presents a similar summary of exponentiated regression beta coefficients for the continuity of care predictor for the cross-sectional MCP sample for a second set of age groups. For FP cost there were small yet significant increases in cost seen for medium-continuity group relative to high for the whole sample (12+) and the 12-19 and 20-44 year age groups (Table 4.47A). With respect to specialist cost, as previously stated, for the whole sample (age 12+) medium-continuity was associated with a 7.2% increase in specialist cost relative to high continuity while low continuity was associated with a small reduction in specialist cost (Table 4.47B). Low-continuity was associated with a larger reduction in specialist cost (23.8%) for the 12-19 age group. In the 45-64 age group, medium-continuity was associated with an increase in specialist cost relative to high-continuity and in the 65-74 and 75+ age groups, low-continuity was associated with increases in specialist cost which amounted 20.6% for the 65-74 age

Table 4.47 Summary of Tobit/OLS Regressions - MCP Sample (N=50,499) (Continuity and Outcomes measured from 1999-2002) (Second Set of Age Groups)

Table 4.47A: Continuity and FP Cost (1999-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	1.00	1.023* (1.012-1.033)	1.001 (0.992-1.011)
12-19	1.00	1.058* (1.025-1.091)	1.006 (0.980-1.032)
20-44	1.00	1.029* (1.014-1.044)	0.998 (0.985-1.011)
45-64	1.00	1.010 (0.993-1.07)	0.982 (0.966-1.001)
65-74	1.00	1.007 (0.970-1.044)	0.990 (0.953-1.028)
75+	1.00	0.958 (0.909-1.010)	0.958 (0.909-1.009)

* indicates significant difference from reference group

Table 4.47B: Continuity and Specialist Cost (1999-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	1.00	1.072* (1.019-1.127)	0.950* (0.906-0.995)
12-19	1.00	0.847 (0.692-1.037)	0.762* (0.644-0.902)
20-44	1.00	1.056 (0.975-1.144)	0.940 (0.875-1.011)
45-64	1.00	1.149* (1.062-1.243)	1.052 (0.971-1.138)
65-74	1.00	1.138 (0.974-1.329)	1.206* (1.031-1.412)
75+	1.00	1.094 (0.915-1.309)	1.293* (1.081-1.546)

* indicates significant difference from reference group

Table 4.47C: Continuity and Total Physician Cost (1999-2000)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	1.00	1.030* (1.011-1.049)	0.979 (0.962-0.996)
12-19	1.00	1.008 (0.954-1.066)	0.934* (0.892-0.978)
20-44	1.00	1.032 (1.005-1.060)	0.971* (0.948-0.994)
45-64	1.00	1.029 (0.995-1.064)	0.985 (0.953-1.019)
65-74	1.00	1.046 (0.976-1.120)	1.025 (0.956-1.099)
75+	1.00	1.006 (0.936-1.083)	1.077* (1.002-1.158)

* indicates significant difference from reference group

Table 4.47D: Continuity and Inpatient Hospital Cost (1999-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	**1.00**	1.059 (0.991-1.131)	1.033 (0.970-1.100)
12-19	**1.00**	0.964 (0.782-.189)	1.037 (0.868-1.240)
20-44	**1.00**	1.009 (0.906-1.123)	0.917 (0.830-1.014)
45-64	**1.00**	1.057 (0.934-1.196)	1.090 (0.960-1.238)
65-74	**1.00**	1.024 (0.842-1.245)	0.993 (0.760-1.120)
75+	**1.00**	1.195* (1.005-1.421)	1.231* (1.041-1.454)

* indicates significant difference from reference group

group and 29.3% for the 75+ age group. Estimates for medium continuity for these two age groups suggested a smaller increase for medium continuity relative to high but increases were not statistically significant. For total physician cost, there were small, though significant, decreases in cost for low-continuity (relative to high) in the 12-19 and 20-44 age groups. There were also significant increases for medium-continuity in the whole sample (age 12+) and the 20-44 age group, as well as an increase in cost for the low continuity group in the 75+ age group (Table 4.47C).

For hospital cost, there were significant increases for low- and medium-continuity (relative to high) in the 75+ age group only, as previously seen. Magnitude of increase was slightly greater for the low continuity group (Table 4.47D).

4.4.2 Longitudinal MCP Analysis (Phase II) (Continuity measured from 1999-2000 and Outcomes measured from 1999-2002)

4.4.2.1 Descriptive Statistics of Cost Outcomes

Table 4.48 presents descriptive statistics for per-patient cost measures for the longitudinal MCP analysis (continuity measured from 1999-2000 and outcomes

Table 4.48: Descriptive Statistics for Per-Person Health Care Services Costs Outcomes for 4-year Period (1999-2002) (MCP Sample) (Continuity measured from 1999-2000 and Cost Outcomes measured from 2001-2002) (N=42,602)

Measure	Mean (SD) (per Person)	Variance	Minimum	Maximum
FP Billings (H&O)	217 (244)	158.88	36.0	4419
Specialists Billings	383 (893)	117.63	0.00	27,561
Total Physician Billings	600 (981)	323.21	36.0	27,984
Inpatient Hospital Costs	1955 (9406)	0.00	0.00	278,434

measured from 2001-2002). Home and office fee-for-service FP visits had a total cost of $9,260,781 and a mean per-person cost of $217 over two years. Specialist costs totalled $16,317,773 with a mean of $383 per person over two years. Total physician costs totalled 25,578,554 with a mean cost of $600 per person over two years. Hospital costs totalled in excess of $83,282,995 with a mean cost of $1955 per person over two years. All four cost measures were positively-skewed and highly variable. Hospital costs were the most variable and the most skewed.

Table 4.49 presents per-person physician cost outcomes by continuity of care level for the longitudinal MCP analysis for the following age groups: 12+ (all ages), 55+, 65+, and 75+. For FP billings significant differences between continuity groups existed

Table 4.49: Physician Costs by Continuity Group by Age Group (MCP Sample) (Continuity (1999-2000) and Outcomes (2001-2002)) (First Set of Age Groups)

Type of Physician Cost	Age Group (Years)	Continuity of Care Level				p-value
		Low (<0.5)	Medium (0.5-0.74)	High (≥0.75)	Overall	
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
FP Cost[1]	12+	193 (221)	222 (238)	227 (255)	217 (244)	< 0.001*
	55+	265 (317)	286 (316)	297 (319)	290 (318)	< 0.001*
	65+	291 (369)	311 (345)	330 (364)	321 (362)	< 0.001*
	75+	297 (436)	327 (386)	361 (433)	344 (426)	< 0.001*
Specialist Cost[1]	12+	317 (740)	402 (921)	405 (942)	383 (893)	< 0.001*
	55+	579 (1164)	699 (1492)	600 (1191)	614 (1243)	0.014*
	65+	606 (1235)	751 (1588)	641 (1291)	654 (1339)	0.074
	75+	511 (988)	562 (930)	570 (1148)	559 (1088)	0.190
Total Physician Cost[1]	12+	510 (830)	623 (1007)	632 (1029)	600 (981)	< 0.001*
	55+	844 (1287)	985 (1583)	898 (1288)	904 (1342)	< 0.001*
	65+	897 (1381)	1063 (1683)	971 (1394)	975 (1446)	0.002*
	75+	808 (1134)	889 (1082)	931 (1283)	904 (1227)	0.008*

[1]Cost per person over 2-year period   * indicates p < 0.05

for all age groups. As in the 4-year MCP analysis, FP costs tended to increase with increasing continuity. For specialist costs there were significant differences between continuity groups for the 12+ and 55+ age groups only and for total physician costs there were significant differences between continuity groups for all age groups. For specialist and total physician costs, for the 12+ and 75+ ages groups, cost tended to increase with increasing continuity level. For the 55+ and 65+ groups the medium continuity group tended to be associated with the highest costs while the low continuity group tended to have the lowest cost.

Table 4.50 presents hospital costs by continuity of care level for the same age groups. The medium continuity group tended to be associated with the highest hospital costs and the low continuity group with the lowest, but between group differences were

Table 4.50: Inpatient Hospital Costs by Continuity Group by Age Group (MCP Sample) (Continuity (1999-2000) and Outcomes (2001-2002)) (First Set of Age Groups)

	Age Grp (Yrs)	Continuity of Care Level				p-value
		Low (<0.5)	Medium (0.5-0.74)	High (≥0.75)	Overall	
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Hospital Cost[1]	12+	1437 (7615)	2161 (11,394)	2109 (9337)	1954 (9406)	<0.001*
	55+	3892 (13,505)	5204 (19,007)	4135 (13,739)	4276 (14,729)	0.263
	65+	4837 (14,829)	6305 (19,498)	5376 (15,941)	5450 (16,442)	0.128
	75+	5361 (14,349)	6928 (20,734)	6365 (17,568)	6296 (17,678)	0.095

[1]Cost per person over 2-year period * indicates $p < 0.05$

statistically significant for the 12+ age group (whole sample) only.

Table 4.51 presents physician costs by continuity of care level for the longitudinal MCP analysis for a second set of age groups. There were significant differences in FP cost between continuity of care groups for all age groups. For the lower age groups, the medium-continuity group tended to be associated with the highest cost while the low-continuity group tended to be associated with the lowest cost. Between-group differences tended to be small. For specialist cost, significant between group differences existed for the three lower age groups, while for total physician costs differences existed for all but the 65-74 age group. The medium-continuity group tended to have the highest cost except for the 75+ age group where the high-continuity group tended to have the highest cost. The low-continuity group tended to have the lowest cost except in the 12+ age group where the high-continuity group had the lowest cost. Total physician costs showed a similar pattern to the specialist costs except that in the 75+ age group the medium-continuity group had the highest cost. Variability was especially high

Table 4.51: Physician Costs by Continuity Group by Age Group (MCP Sample) (Continuity (1999-2000) and Outcomes (2001-2002)) (Second Set of Age Groups)

Type of Physician Cost	Age Group (Years)	Continuity of Care Level				p-value
		Low (<0.5)	Medium (0.5-0.74)	High (≥0.75)	Overall	
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
FP Cost[1]	12-19	141 (145)	154 (163)	128 (144)	139 (148)	<0.001*
	20-44	176 (183)	200 (196)	181 (201)	183 (195)	<0.001*
	45-64	215 (230)	232 (237)	230 (221)	228 (226)	<0.001*
	65-74	286 (301)	299 (309)	308 (301)	304 (303)	0.006*
	75+	297 (435)	327 (386)	360 (433)	344 (426)	<0.001*
Specialist Cost[1]	12-19	144 (354)	159 (386)	129 (296)	141 (340)	<0.001*
	20-44	248 (571)	284 (535)	258 (644)	261 (601)	<0.001*
	45-64	439 (864)	487 (990)	466 (990)	465 (968)	0.001*
	65-74	686 (1407)	899 (1940)	693 (1386)	727 (1499)	0.149
	75+	511 (988)	562 (930)	570 (1147)	559 (1087)	0.190
Total Physician Cost[1]	12-19	285 (414)	313 (470)	257 (360)	280 (407)	<0.001*
	20-44	424 (639)	483 (620)	439 (709)	445 (670)	<0.001*
	45-64	654 (952)	719 (1072)	696 (1066)	693 (1047)	<0.001*
	65-74	972 (1557)	1198 (2020)	1001 (1470)	1030 (1590)	0.103
	75+	5361 (14,348)	6928 (20,734)	6365 (17,568)	6296 (17,678)	0.008*

[1]Cost per person over 2-year period * indicates $p < 0.05$

for the 75+ age group for total physician cost.

Table 4.52 presents hospital cost by continuity of care group for the same set of age groups. Although there were no statistically significant differences in hospital cost between continuity groups, the medium continuity group tended to have the highest cost across age groups. The high continuity group tended to have the lowest cost for the two lower age groups while the low continuity group tended to have the lowest cost for the three upper age groups.

Table 4.52: Inpatient Hospital Costs by Continuity Group by Age Group (MCP Sample) (Continuity (1999-2000) and Outcomes (2001-2002)) (Second Set of Age Groups)

	Age Grp (Yrs)	Continuity of Care Level Low (<0.5)	Medium (0.5-0.74)	High (≥0.75)	Overall	p-value
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Hospital Cost[1]	12-19	734 (6906)	894 (6496)	508 (2390)	680 (5506)	0.357
	20-44	795 (4090)	1076 (6743)	799 (3811)	855 (4675)	0.140
	45-64	1663 (8205)	2142 (12,247)	1827 (8364)	1853 (9164)	0.238
	65-74	4390 (15,223)	5822 (18,482)	4640 (14,576)	4803 (15,402)	0.713
	75+	5361 (14,348)	6928 (20,734)	6365 (17,568)	6296 (17,678)	0.095

[1]Cost per person over 2-year period * indicates p < 0.05

4.4.2.2 Multivariate Analysis of Cost Outcomes

Tables 4.53 to 4.56 present the results of the final step of tobit analysis showing factors associated with physician cost for the longitudinal MCP sample (examining continuity from 1999-2000 and cost outcomes from 2001-2002 (ages 12+)). For FP cost, low-continuity was associated with a cost reduction of 10.6 % relative to high-continuity (Table 4.53). Other factors associated with FP cost included age, gender, number of chronic illnesses, rural-urban status, income quintile, and number of FP visits.

There was no association of continuity level with specialist cost (Table 4.54). Age, gender, number of chronic illnesses, rural/urban status, income quintile, and number of FP visits were associated with specialist cost. Results for total physician cost were, for the most part, intermediate between that of the FP and specialist cost analyses (Table 4.55). Low continuity was associated with an 8.6% reduction in total physician costs. There was no association of age with total physician cost. Other factors associated with total physician cost included gender, number of chronic illnesses, rural/urban status,

Table 4.53: Factors Associated with FP Cost (MCP Sample) Continuity (1999-2000) and Outcomes (2001-2002); Ages 12+ (N=42,602)

Characteristic	Adjusted Analysis Rate Ratio (95 % C.I.)
Continuity of FP Care	
High (≥0.75)	**1.00**
Medium (>0.5 but < 0.75)	0.974 (0.937-1.013)
Low (< 0.5)	0.894* (0.862-0.927)
Age	0.994* (0.993-0.995)
Gender	
Female	1.404* (1.361-1.447)
Number of Chronic Conditions	
0	**1.00**
1	1.597* (1.532-1.663)
2+	2.587* (2.475-2.703)
Income	
Q1	**1.00**
Q2	0.820* (0.774-0.868)
Q3	0.889* (0.842-0.938)
Q4	0.961 (0.916-1.008)
Q5	0.995 (0.951-1.040)
Rural/Urban	
Rural	**1.000**
Urban	1.115* (1.074-1.156)
Number of FP Visits	
High	**1.00**
Medium	0.568* (0.546-0.591)
Low	0.321* (0.309-0.333)

* indicates significant difference from reference group

Table 4.54: Factors Associated with Specialist Cost (MCP Sample) Continuity (1999-2000) and Outcomes (2001-2002); Ages 12+ (N=42,602)

Characteristic	Adjusted Analysis Rate Ratio (95 % C.I.)
Continuity of FP Care	
High (≥0.75)	**1.00**
Medium (>0.5 but < 0.75)	1.080 (0.999-1.167)
Low (< 0.5)	0.950 (0.883-1.021)
Age	1.015* (1.013-1.117)
Gender	
Female	1.821* (1.713-1.936)
Number of Chronic Conditions	
0	**1.00**
1	2.210* (2.035-2.401)
2+	5.222* (4.782-5.704)
Income	
Q1	**1.00**
Q2	0.722* (0.645-0.809)
Q3	0.754* (0.677-0.840)
Q4	0.826* (0.752-0.907)
Q5	0.805* (0.737-0.879)
Rural/Urban	
Rural	**1.00**
Urban	1.299* (1.207-1.397)
Number of FP Visits	
High	**1.00**
Medium	0.579* (0.536-0.625)
Low	0.340* (0.315-0.366)

* indicates significant difference from reference group

Table 4.55: Factors Associated with Total Physician Cost (MCP Sample) Continuity (1999-2000) and Outcomes (2001-2002); Ages 12+ (N=42,602)

Characteristic	Adjusted Analysis Rate Ratio (95 % C.I.)
Continuity of FP Care	
High (≥ 0.75)	**1.00**
Medium (> 0.5 but < 0.75)	1.008 (0.967-1.051)
Low (< 0.5)	0.924* (0.889-0.961)
Age	1.001 (0.999-1.002)
Gender	
Female	1.411* (1.366-1.458)
Number of Chronic Conditions	
0	**1.00**
1	1.663* (1.592-1.738)
2+	2.894* (2.760-3.034)
Income	
Q1	**1.00**
Q2	0.839* (0.789-0.892)
Q3	0.873* (0.823-0.925)
Q4	0.932* (0.886-0.981)
Q5	0.934* (0.891-0.980)
Rural/Urban	
Rural	**1.000**
Urban	1.182* (1.136-1.229)
Number of FP Visits	
High	**1.00**
Medium	0.626* (0.600-0.652)
Low	0.380* (0.365-0.396)

* indicates significant difference from reference group

Table 4.56: Factors Associated with Inpatient Hospital Cost (MCP Sample) Continuity (1999-2000) and Outcomes (2001-2002); Ages 12+ (N=42,602)

Characteristic	Adjusted Analysis Rate Ratio (95 % C.I.)
Continuity of FP Care	
High (≥0.75)	**1.00**
Medium (> 0.5 but < 0.75)	1.104 (0.977-1.247)
Low (< 0.5)	1.135* (1.007-1.280)
Age	1.016* (1.013-1.108)
Gender	
Female	0.871* (0.789-0.961)
Number of Chronic Conditions	
0	**1.00**
1	0.936 (0.796-1.100)
2+	1.188* (1.012-1.245)
Income	
Q1	**1.00**
Q2	1.188 (1.011-1.396)
Q3	1.041 (0.870-1.245)
Q4	1.036 (0.875-1.225)
Q5	0.912 (0.784-1.062)
	1.032 (0.891-1.195)
Rural/Urban	
Rural	**1.00**
Urban	1.147* (1.025-1.284)
Number of FP Visits	
High	**1.00**
Medium	0.991 (0.878-1.118)
Low	0.995 (0.881-1.123)

* indicates significant difference from reference group

income quintile, and number of FP visits.

Table 4.56 presents the results of the final step of an OLS regression analysis for hospital cost for the longitudinal MCP sample examining continuity from 1999-2000 and cost outcomes from 2001-2002 (age 12+), omitting cases with zero hospital cost. Low-continuity was associated with a 13.5% increase in hospital cost. Age, gender, and number of chronic illnesses were also associated with hospital cost.

Tables for similar regression analyses for age groups 55+, 65+, and 75+ as well as for the 12-19, 20-44, 45-64, and 65-74 age group are presented in Appendix N.

Table 4.57 presents a summary of exponentiated beta values for the continuity of care predictor for regression analysis of each cost outcome for the longitudinal MCP analysis by age group. For FP cost, the only statistically significant result was an observed 34% decrease for the 75+ age group only (Table 4.57A) in cost for the low-continuity group relative to high-continuity. No association of continuity level was seen with either specialist or total physician cost at any age group (Tables 4.57B and C). For hospital cost, the only significant result was a 13.5% increase in cost for the low continuity group relative to the high continuity group for the whole sample (age 12+), although the lower confidence interval was very close to 1 (Table 4.57D). Regression estimates were mostly in the 1.10 to 1.17 range for both medium and high continuity for the 12+, 55+, and 65+ age groups, but did not reach statistical significance. For the 75+ age group the value for the low continuity group was markedly higher than that for medium, but again not statistically significant.

Table 4.57 Summary of Tobit/OLS Regressions - MCP Sample (N=42,602)
(Continuity measured from 1999-2000 and outcomes measured from 2001-2002)

Table 4.57A: Continuity (1999-2000) and FP Cost (2001-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	**1.00**	0.974 (0.937-1.013)	0.894 (0.862-0.927)
55+	**1.00**	0.885 (0.810-0.967)	0.798 (0.729-0.873)
65+	**1.00**	0.865 (0.755-0.9920	0.764 (0.663-0.881)
75+	**1.00**	0.782 (0.606-1.010)	0.660* (0.509-0.857)

* indicates significant difference from reference group

Table 4.57B: Continuity (1999-2000) and Specialist Costs (1999-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	**1.00**	1.080 (0.999-1.167)	0.950 (0.883-1.021)
55+	**1.00**	1.061 (0.920-1.222)	1.089 (0.941-1.258)
65+	**1.00**	1.024 (0.837-1.253)	1.081 (0.876-1.332)
75+	**1.00**	0.865 (0.618-1.212)	0.891 (0.632-1.255)

* indicates significant difference from reference group

Table 4.57C: Continuity (1999-2000) and Total Physician Costs (1999-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	**1.00**	1.008 (0.967-1.051)	0.924 (0.889-0.961)
55+	**1.00**	0.973 (0.885-1.069)	0.925 (0.840-1.019)
65+	**1.00**	0.947 (0.819-1.095)	0.910 (0.782-1.059)
75+	**1.00**	0.815 (0.624-1.065)	0.806 (0.614-1.059)

* indicates significant difference from reference group

Table 4.57D: Continuity (1999-2000) and Inpatient Hospital Costs (1999-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	**1.00**	1.104 (0.977-1.247)	1.135* (1.007-1.280)
55+	**1.00**	1.175 (0.986-1.398)	1.132 (0.942-1.359)
65+	**1.00**	1.161 (0.931-1.447)	1.119 (0.880-1.423)
75+	**1.00**	1.016 (0.753-1.371)	1.177 (0.845-1.639)

* indicates significant difference from reference group

Table 4.58 presents a summary of exponentiated beta values for the continuity of care predictor for regression analysis of each cost outcome for the longitudinal MCP sample for a second set of age groups. For FP costs, there was a significant increase in cost for medium-continuity (relative to high) for the 12-19 year age group and significant decreases in costs for low continuity (relative to high) for the 45-64 and 75+ age groups of 10.3% and 34.0% respectively (Table 4.58A). As in Table 4.78 above, there was no significant association of continuity with either specialist cost or total physician cost (Tables 4.58B and C).

For hospital cost significant reductions were seen for low continuity relative to high for the whole sample (age 12+) and the 45-64 age group (13.5% and 26.2% respectively) (Table 4.58D).

4.5 Summary of Results

4.5.1 Health Care Utilization

4.5.1.1 Phase I:

In Phase I of the study, the Newfoundland Labrador Sample of Canadian Community Health Survey Version 1.1 (2000/01) Share File (N=3730) was linked to provincial physician visits and hospital separation data via provincial health insurance number or name/date of birth. The final study sample consisted of 2091 survey respondents. Continuity and outcomes were measured over the four-year period ± 2 years from CCHS survey data for each survey participant. After index calculation, 54.7% of survey participants fell into the high continuity group. Significant differences existed

Table 4.58 Summary of Tobit/OLS Regressions - MCP Sample (N=42,602) (Continuity measured from 1999-2000 and Outcomes measured from 2001-2002) (Second Set of Age Groups)

Table 4.58A: Continuity (1999-2000) and FP Cost (2001-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	**1.00**	0.974 (0.937-1.013)	0.894 (0.862-0.927)
12-19	**1.00**	1.209* (1.063-1.374)	1.080 (0.971-1.202)
20-44	**1.00**	1.036 (0.980-1.094)	0.976 (0.928-1.026)
45-64	**1.00**	0.955 (0.901-1.013)	0.897* (0.846-0.950)
65-74	**1.00**	0.932 (0.806-1.080)	0.853 (0.731-0.996)
75+	**1.00**	0.782 (0.606-1.010)	0.660* (0.509-0.857)

* indicates significant difference from reference group

Table 4.58B: Continuity (1999-2000) and Specialist Cost (2001-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	**1.00**	1.080 (0.999-1.167)	0.950 (0.883-1.021)
12-19	**1.00**	1.132 (0.826-1.551)	1.001 (0.769-1301)
20-44	**1.00**	1.112 (0.984-1.257)	1.004 (0.897-1.124)
45-64	**1.00**	1.138 (1.013-1.278)	1.114 (0.992-1.251)
65-74	**1.00**	1.179 (0.921-1.509)	1.270 (0.978-1.648)
75+	**1.00**	0.865 (0.618-1.212)	0.891 (0.632-1.255)

* indicates significant difference from reference group

Table 4.58C: Continuity (1999-2000) and Total Physician (2001-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	**1.00**	1.008 (0.967-1.051)	0.924 (0.889-0.961)
12-19	**1.00**	1.169 (1.019-1.340)	1.050 (0.938-1.177)
20-44	**1.00**	1.050 (0.991-1.111)	0.986 (0.935-1.039)
45-64	**1.00**	1.011 (0.949-1.076)	0.973 (0.915-1.036)
65-74	**1.00**	1.069 (0.911-1.254)	1.005 (0.849-1.191)
75+	**1.00**	0.815 (0.624-1.065)	0.806 (0.614-1.059)

* indicates significant difference from reference group

Table 4.58D: Continuity (1999-2000) and Inpatient Hospital Cost (2001-2002)

Age Group (Years)	Rate Ratios		
	Continuity Group		
	High	Medium	Low
12+	1.00	1.104 (0.977-1.247)	1.135* (1.007-1.280)
12-19	1.00	1.443 (0.977-2.128)	1.345 (0.958-1.888)
20-44	1.00	0.956 (0.772-1.184)	1.007 (0.824-1.230)
45-64	1.00	1.187 (0.943-1.494)	1.262* (1.007-1.582)
65-74	1.00	1.332 (0.963-1.842)	1.071 (0.756-1.517)
75+	1.00	1.016 (0.753-1.371)	1.177 (0.845-1.639)

* indicates significant difference from reference group

between continuity groups with respect to all socio-demographic (e.g. age, sex, education) and health status co-variates (number of chronic illnesses and number of FP visits). There were no differences between continuity groups with respect to heath behaviour co-variates (e.g. smoking, drinking, physical activity). Analyses performed by age group revealed that utilization of all health care services and number of chronic illnesses increased with age, and as age increased there were fewer differences in utilization and co-variates between continuity groups. The proportion of people in the high continuity group also increased with age.

Unadjusted descriptive statistics for the whole sample (age 12+) showed that medium continuity was associated with the most total specialist and ambulatory specialist use while there were no between-group differences in the number of hospital separations. However, when analyses were performed by age group, as age increased, there was a transition towards specialist and ambulatory specialist utilization tending to increase with decreasing continuity level in the higher age groups. For hospital separations, there was no significant difference between continuity groups at any age group, but at the 55+ age group there was a trend towards number of hospital separations increasing with decreasing continuity level, a trend which became more pronounced in the 65+ age group.

The multivariate analysis more or less mirrored what was found in the descriptive statistics. For the whole sample for specialist visits and hospital separations, both the low- and medium- continuity groups showed significantly higher utilization than the high continuity group with the increase being higher for the medium continuity group. In the 55+ age group there was a shift towards utilization being the highest for low continuity and tending to decrease with the increasing continuity. For ambulatory specialist visits, utilization increased with decreasing continuity for all age groups, although the differences for medium continuity relative to high did not reach statistical significance in all age groups. Increases in health care utilization for the low and medium continuity groups, relative to high continuity, was ranged from between 11.5% and 55% higher in the 12+ age group to between 65.2 and 87.3% in the 75+ age group.

4.5.1.1 Phase II:

Phase II utilized a randomly-selected sample of 80,000 individuals from the MCP Provincial health insurance registration file. The sample was linked to provincial physician visits and hospital separation data via provincial health insurance number. Phase II involved two separate analyses of the MCP sample: a cross-sectional analysis and a longitudinal analysis.

4.5.1.1.1 Phase II Cross-sectional Analysis

In the first MCP analysis, termed the cross-sectional analysis, continuity and health care utilization were measured over the same 4-year period (1999-2002). After exclusions, the final study sample was 50,499 individuals. The results had many similarities to those seen in Phase I. After index calculation, 51.0% of patients fell into the high continuity group. Significant differences existed between continuity groups with respect to all socio-demographic and health status co-variates. Analyses were performed for two sets of age groups. Again, as age increased, health care services utilization and number of chronic illnesses increased and between-group differences among utilization measures and co-variates between continuity groups were reduced. The proportion of people in the high continuity group increased with increasing age group until the 75+ age group was reached, at which point the proportion decreased slightly. Unlike the other age groups, for the 12-19 age group, the low continuity group had the highest proportion of people.

Unadjusted descriptive statistics for the whole sample (age 12+) showed that the medium continuity group had the highest utilization for ambulatory specialist contacts while the high continuity group had the highest for the other three utilization measures. The low continuity group had the lowest utilization for all four measures. As age increased, there was a shift seen for most measures towards a trend where utilization increased significantly with decreasing continuity level. The shift was most pronounced for the oldest age group (75+). For ambulatory specialist visits differences between continuity groups did not reach statistical significance at higher age groups. For hospital separations for ACSCs at the 75+ age group the low and medium continuity groups had similar utilization levels, slightly higher than that of the high continuity group.

In an analysis of the MCP sample with a second set of age groups (12-19, 20-44, 45-64, 65-74 and 75+), for the lower age groups medium continuity was associated with the highest utilization for specialist contacts, ambulatory specialist contacts and hospital separations. As seen above for the 75+ age group, ambulatory specialist and hospital utilization increased with decreasing continuity level while for hospital separations for ACSCs, as stated above, the low and medium continuity group had similar utilization levels which were higher than that of the high continuity group.

The multivariate analysis for the most part confirmed what was found in the descriptive analysis. Health care utilization measures tended to be greater in the low and medium continuity group relative to the high continuity group and this difference became more pronounced with age. In the 12+ and 55+ age groups the medium continuity group tended to have the highest utilization. For hospitalizations and specialists visits, in the 65+ age group a shift started to occur where the low continuity group tended to have the highest utilization and this trend became more pronounced in the 75+ age group. For hospitalizations for ACSCs differences grew with age, but the shift in utilization patterns was not seen and the medium continuity had slightly higher utilization for all age groups. For ambulatory specialist visits medium continuity had slightly higher utilization than high continuity while utilization for low continuity was similar of that for high continuity. Increases in health care utilization seen here in the cross-sectional analysis of Phase II for low and medium continuity were smaller than those seen in Phase I ranging between

2.7% and 13.2% in the 12+ age group to between 11.7 %and 19.3% for specialists visits and total hospitalizations to as high as 50.2 % for hospitalizations for ACSCs.

Multivariate analysis by the second set of age groups yielded few differences in utilization across age groups other than that described above for the 75+ age group. However, there was evidence of a reduction in hospitalization in the low continuity group in the 12-19 and the 20-44 age group and of a reduction in specialist visits in the 12-19 age group.

4.5.1.1.2 Phase II Longitudinal Analysis

In the second MCP analysis (longitudinal analysis), continuity was measured over two years (1999-2000) and health care utilization over the following 2 years (2001-2002). After exclusions the final sample was 42,602 individuals, approximately 8000 fewer than the sample used for the first analysis. After index calculation, 55.9% of patients fell into the high continuity group. As in Phase I and the first analysis in Phase II, significant differences existed between continuity groups with respect to socio-demographic and health status co-variates. Analyses were performed for two sets of age groups. Again, as age increased, health care services utilization and number of chronic illnesses increased and significant differences in utilization measures and co-variates between continuity groups were reduced. The proportion of people in the high continuity group increased with increasing age group until the 75+ age group was reached, at which point the proportion decreased slightly. Unlike the other age groups, for the 12-19 age group, the low continuity group had the highest proportion of people.

Unadjusted descriptive statistics showed that the medium continuity group had the highest specialist, ambulatory specialist and hospital utilization, although differences were not significant for the 75+ age group. For hospital separations for ACSCs the high continuity group has the highest utilization for the whole sample and at the 75+ age group there was a non-significant trend towards the utilization increasing with decreasing continuity levels.

The descriptive analysis for the second set of age groups showed medium continuity to have the highest specialist and ambulatory specialist utilization in the three lower age groups as well as non-significant trends towards medium continuity having the highest specialist and ambulatory specialist utilization for the upper two age groups. The two hospital measures showed no between-group differences at any age group. For hospitalization there was general trend towards medium continuity having the highest utilization while hospitalizations for ACSCs showed a trend towards utilization increasing with decreasing continuity in the 75+ age group.

The multivariate analysis, for the most part confirmed the descriptive analysis. The medium continuity group tended to have the highest magnitude for most outcomes across age groups, demonstrating slightly higher hospital and specialist utilization than the high continuity group (approximately 5 to 10% higher), although differences were not always statistically significant. The low continuity group tended not to be significantly different from the high continuity group. However, for hospitalizations for ACSCs both the medium and low continuity groups had a greater number of hospitalizations than the high continuity group, although differences were not statistically significant at the lower age groups. This trend became more pronounced with age and at the 75+ there was a shift to a "dose-response" relationship where hospitalization for ACSCs increased with decreasing continuity where the medium continuity group had 25% more hospitalizations for ACSCs relative to the high continuity group and the medium continuity group had 35% more.

In the multivariate analysis using the second set of age groups there were few differences in utilization between continuity groups, other than those described above. There were slight increases in the medium continuity group in all outcomes except ambulatory specialists visits at the 65-74 age group and for ambulatory specialist visits at the 20-44 and 45-64 age groups.

4.5.2 Health Care Costs

Cost analyses were conducted for each of the two Phase II samples using the same predictor variables as used in the utilization analyses using the following cost outcomes variables: cost of FP visits, special visits, total physician visits and hospital separations.

4.5.2.1 Phase II Cross-sectional Analysis

In the cross-sectional cost analysis using the Phase II sample (MCP sample with continuity and outcomes measured over 4 years) FP cost was highest in the medium continuity group for the whole sample and the 55+ and 65+ age groups with a non-significant trend towards high continuity having the highest costs for the 75+ age group. For specialist and total physician costs there was a transition from the high continuity group having the highest cost in the whole sample, to the medium continuity group having the highest for 55+, to cost increasing with decreasing continuity in the 75+ group, although statistical significance was not reached for total physician cost. Hospital cost showed a similar transition. Results seen here with specialist and hospital cost were similar to specialist and hospital utilization results seen above.

In a descriptive analysis using the second set of age groups, the medium-continuity group tended to have the highest costs for all four measures in the lower three age groups. For FP visits there was transition towards the high-continuity group having the highest cost in the two highest age groups (65-74 and 75+). The other three costs measures showed a transition towards costs tending to increase with decreasing continuity in the 75+ age group as seen above.

The multivariate analysis using the first set of age groups for the most part confirmed the descriptive results. FP cost for the whole sample was highest for the medium continuity group while no differences in FP cost were found at the higher age groups. For specialist and total physician cost there was a shift from medium continuity having the highest cost, to cost increasing with decreasing continuity at the higher age groups. Differences for the medium continuity group were not always significant for specialist or total physician costs. For hospital cost there was a transition from no between-group differences to where cost increased with decreasing continuity. Increases in specialist costs for the low and medium continuity groups relative to high continuity ranged from 7.2% for the whole sample to 29.3% for the 75+ age group and increases seen for hospital cost ranged from 11.7% in the 55+ age group to 23.1% in the 75+ age group.

Similar results were seen in an analysis using the second set of age groups. In this analysis in the low continuity group there was actually a reduction in specialist cost seen for the 12-19 age group and a reduction in total physician cost for the 12-19 and 20-44 age groups.

4.5.2.2 Phase II Longitudinal Analysis

In the longitudinal cost analysis using the Phase II sample (MCP sample with continuity measured from 1999-2000 and outcomes measured from 2001-2002) using the first set of age groups, FP cost increased with increasing continuity level. Specialist and total physician cost tended to increase with increasing continuity for the whole sample as well as in the 75+ age group, while in the 55+ and 65+ age groups the medium continuity group tended to have the highest costs. Hospital cost tended to be highest in the medium-continuity group; however, differences between continuity groups only reached statistical significance for the whole sample (ages 12+).

Using the second set of age groups, FP and specialist cost showed a transition from cost being highest in the medium-continuity group in the younger age groups to cost tending to increase with increasing continuity. For total physician cost, the medium-continuity group tended to have the highest cost for all age groups. For hospital cost there was a non-significant trend towards medium-continuity being associated with the highest cost for all age groups. There were similarities between the results seen here with specialist and hospital cost and those for specialist and hospital utilization described earlier with the medium-continuity group often tending to be associated with the highest utilization and costs.

In the multivariate analysis, using the first set of age groups, there were no differences in cost for specialist or total physician cost between continuity levels. For FP cost there were no between-group differences for the whole sample, or the 55+ and 65+ age groups, but the low continuity group was associated with a large cost reduction for the 75+ age group. For hospital cost there was an increase in cost seen with low continuity for the whole sample but no differences were seen at any other age group.

In the multivariate analysis using the second set of age groups, as in the first analysis, there were no differences between continuity groups seen for specialist or total physician costs. For FP cost an increase was seen for the medium continuity group (but not the low) in the 12-19 age group and cost decreases were seen for low continuity in the 45-64 and the 75+ age groups. Hospital costs were higher for low continuity for the whole sample and the 45-64 age group with the magnitude of increase (relative to high continuity) being greater for the 45-64 age group (26.2%), than for the whole sample (13.5%).

CHAPTER 5: DISCUSSION

5.1 Study Samples and Continuity of Care Levels

We used survey and administrative data to investigate the relationship of continuity of FP care with health care services utilization and costs, as well as to examine the effect of age on these relationships. Two samples were used to investigate the research questions. The first was a provincial sample of the national health survey, the CCHS, numbering just over 2000 individuals (Phase I) while the second was a sample of just over 50,000 from the provincial health insurance registry file (Phase II). For each sample, an analysis of continuity of care and utilization and cost outcomes was conducted over a four-year period. In Phase II, a second longitudinal analysis was conducted where continuity was analyzed over the first two years of the four-year period and outcomes were analyzed during the last two years with a final sample size of just over 42,000. The survey sample was relatively small but provided more co-variate variables to aid in investigation of the research questions while the registry sample was larger but had fewer co-variates available to use in the analysis. Use of the two samples was intended to provide complementary and robust evidence in the investigation of the research questions.

Overall, continuity of FP care, measured by the Continuity of Care index (COC index), ranged between 0.71 and 0.74 in the three analyses used in our study. These values were higher than found in most other studies of continuity of primary care. For example, Reid et al. found an average value of 0.57 for this index in a sample of British

Columbia residents, Wasson et al. found continuity of care index values of 0.21 in the low continuity group and 0.42 in the high continuity group in a sample of US men aged 55+ attending a veterans' clinic in Vermont, while Gill and Mainous found average values of 0.48 and 0.51 for hospitalized and non-hospitalized patients respectively in a Delaware Medicaid sample aged 0-64. The high continuity values seen in the current study may be due to the fact that the Newfoundland and Labrador MCP physician claims file only captures visits to fee-for-service physicians which are mostly in urban areas. Physicians in rural areas, where continuity of care may be lower due to high physician turn-over and health care access problems, are mostly salaried and not captured in the database. Thus, the study may be overestimating continuity of care levels in the province. High continuity levels also suggest that a lot of FP visits may have been prescheduled, especially for older people and the chronically ill.

Most research studies of the association of continuity of primary care provider and health care services utilization/costs which utilize a visit-based index of continuity use a binary continuity variable (i.e. high and low continuity categories) with cut-offs of either 0.5 or 0.75 between categories (Gill and Mainous, 1998; Mainous and Gill, 1998; Menec et al., 2005; Menec et al., 2006). Reid et al. (2003), who used continuity quintiles, had the most continuity categories of these studies. In our study we wanted to use more than two continuity categories in order to obtain more information about the relationship between continuity and health care services. We decided against using continuity quintiles because we felt that with five categories, the small size of the CCHS sample would not have allowed for sufficient numbers in the categories. Therefore, we decided to use a three-category continuity variable (COC index values of <0.5, ≥ 0.5 and < 0.75, ≥ 0.75) where there were substantial numbers in each category.

5.2 Co-variate Measures

5.2.1 Comparison of Samples

Descriptive statistics of co-variates showed the Phase I (CCHS) and Phase II 4-year sample (cross-sectional sample) to be similar except that the MCP sample had a higher proportion of people from rural areas (58.5 vs. 31.3), a higher average age (44.4 vs. 43.4) and poorer health status as evidenced by a higher average number of chronic illnesses (1.44 vs. 1.14), as well as higher numbers of FP visits (19.20 vs. 18.12), specialist contacts (17.28 vs. 11.64), ambulatory specialist contacts (4.93 vs. 4.71) and hospitalizations (0.53 vs. 0.48).

The rural-urban differences were probably due to a sampling bias towards urban areas in the CCHS as well as due to the different definitions of urban and rural used in the CCHS and MCP samples described in the 'Methodology' section. The higher number of chronic conditions in the MCP sample may have been due to a higher proportion of rural residents as well as due to the fact that chronic conditions come from physician and hospital diagnosis codes in the MCP sample but were self-reported in the CCHS. It may be that those who seek health care services are more likely to have an illness than a community sample such as the one selected in the CCHS. In addition, people may have under-reported chronic illnesses in the CCHS due to recall bias (i.e. not being able to remember having the disease) or due to social desirability bias (i.e. not reporting having a disease because of feelings of embarrassment or a feeling that having the disease is socially undesirable). However, given that the MCP sample did show higher levels of health care service utilization outcomes, all of which were measured in the same fashion for both samples, it does appear that people in the MCP sample were sicker than those in the CCHS sample.

People in the longitudinal MCP sample appeared to be slightly older and sicker than the cross-sectional MCP sample, as evidenced by an even higher number of chronic illnesses and higher number of FP visits (after multiplying by two to account for the two-year time period in this analysis). This was probably due to exclusion of about 8000 younger, healthier individuals who had met the inclusion criteria for three FP visits in a four-year period (for the cross-sectional sample), but who had less than three FP visits in the two-year period and thus were excluded from the longitudinal sample. Number of total specialist visits was slightly higher in the MCP longitudinal sample than that of the cross-sectional sample, while number of ambulatory specialist visits and hospitalizations were similar among the two MCP samples.

5.2.2 Relationship between Co-variates and Continuity of Care

Significant differences existed between continuity groups for most co-variates. For example, those with higher continuity were more likely to be male, older and to have more chronic illness and more FP visits. In general, as we move to the older age groups fewer differences in co-variates between continuity groups are seen. For example, differences seen in the whole sample (ages 12+) between continuity groups with respect to age, marital status, income, and rural-urban status, all become non-significant as we move to the 55+ and 65+ age groups (Tables 4.2, M1 and M4). This is consistent with another study of continuity of care and hospitalization in Canada, which found little difference in socio-demographic characteristics between people of different continuity levels in a sample of people age 67 and older (Menec et al., 2006). Overall, as expected, health status decreased with age as indicated by increases in number of chronic illnesses and health care services utilization measures and associated costs. An exception to this was that in the both MCP samples average number of specialist and ambulatory specialist visits for the 75+ age group were lower than for the 65+ or 65-74 age groups. This was also true for specialist costs and for total physician costs in the cross-sectional analysis. An explanation for this may be that the 75+ includes a significant proportion of institutionalized elderly, who may be less likely to see specialists than people living in the community.

5.2.3 Relationship of Co-variates with Health Care Services Utilization and Cost Outcomes

As described in Andersen's model (Andersen, 1995), use of health service is influenced by several types of population characteristics including predisposing characteristics, need factors and enabling characteristics, each of which were used a co-variates in the current study. The overall relationship between co-variates and outcomes in the multivariate analyses for ages 12+ are discussed below.

5.2.3.1 Predisposing Characteristics

Predisposing characteristics are factors which predispose the individual to using health care service. After adjusting for co-variates in the multivariate analyses, overall, increasing age was associated with an increase in health care services utilization and costs as has been reported in the literature (Steven et al., 1998; Ettner, 1999). Overall, in the two MCP samples (cross-sectional and longitudinal) females tended to have higher levels of specialist and ambulatory specialist utilization (Tables 4.21, 4.22, 4.33 and 4.34), as well as higher FP, specialist and total physician costs (Tables 4.42, 4.43, 4.44, 4.53,4.54 and 4.55), which is similar to findings of other researchers who have shown that women are more likely than men to use primary care physician and specialty services as well as preventive and diagnostic services and to have higher associated costs (Krasnik et al. 1997; Bertakis et al., 2000; Ladwig et al., 2000; Redondo-Sendino et al, 2006). In the CCHS analysis, females had higher total specialist utilization than males for the whole sample (ages 12+) but there was no gender difference in number of ambulatory specialists visits (Tables 4.10 and 4.11). For the 55+ and 65+ age groups there were no gender differences for either of the two specialists outcomes, which may have been due to small sample size (Appendix N).

At older age groups in the MCP analyses, however, males actually tended to have higher specialist and ambulatory specialist utilization than females (Appendix N). Given that specialist and ambulatory specialist contacts in our study include ER visits, this finding may be explained by males at older age groups tending to have more ER visits than females. This explanation is supported by other research, which has found males to have a higher number of ER visits than females (Redono-Sendino et al., 2006).

There was little difference in total hospitalization between males and females (Tables 4.9, 4.31), which is similar to that found in other research (Bertakis et al., 2000). Males had higher hospitalization rates for ACSCs than females (Tables 4.20, 4.32), which is supported by other research which has shown hospitalization to be higher in males (Fernandez et al., 1999; Dunlop et al., 2002). Also, in our study males tended to have higher hospital costs than females (Tables 4.45 and 4.56) similar to the results of a study using case-costing data from Ontario and Alberta, which found that males had a 10% higher average cost per acute hospital stay than females (Ariste et al., 2009). This finding may be explained by the tendency for males to be more likely to be hospitalized for more serious health conditions. The study found that males had higher total acute care hospital costs for 11 of the 15 most expensive health conditions including myocardial infarction, angina pectoris and colorectal cancer. Yet another study has shown that males were more likely to be hospitalized for coronary heart disease and re-vascularization procedures in British Columbia, Canada (Morettin et al., 2000).

Finally, with respect to marital status, which was only available in the CCHS analysis, un-partnered marital status was associated with more hospital utilization relative to partnered in the 55+ and 65+ age groups. These findings are consistent with literature which has found married people to have better health status, and lower disability and mortality rates than unmarried people in studies of older populations, which may be due to reduced stress and higher levels of social support and material resources (Wyke and Ford, 1992; Goldman et al., 1995).

5.2.3.2 Need Factors

Need factors are those which determine the individual's need for health care services. Only one need factor was included in analyses in the form of the 'number of chronic conditions' variable. In the current study, having one chronic illness was not associated with any change in hospitalization relative to having no chronic illnesses, while having two or more chronic conditions was associated with increased hospitalization and hospital costs compared to having no chronic illness. Having one chronic condition tended to be associated with increased specialist utilization and costs relative to having no chronic conditions as well as with increases in physician costs measures, although the differences did not reach statistical significance in the CCHS (Phase I) analysis probably because of the small sample size. Having two chronic illnesses was associated with even greater increases in physician utilization and costs relative to having no chronic illness. These patterns of associations of chronic illness with hospitalizations/specialist contacts and costs observed in the current study are similar to those found in a large study using health survey data in Canada and the US (Blackwell et al., 2009). The findings are also supported by other research in the US which has found a person's health care expenses to increase rapidly with increasing number of chronic conditions, and the number of chronic conditions to be a significant predictor of hospital admissions, readmissions and costs (Hwang et al., 2001; Friedman et al., 2006). It has been suggested that the high cost of chronic illness may be partially due to inadequate adherence by physicians to recommended care for conditions such as hypertension, diabetes, heart disease and schizophrenia (McGlynn et al., 2003; Friedman et al., 2006), or to inadequate primary prevention of chronic illness or secondary prevention of acute exacerbations (Friedman et al., 2006).

5.2.3.3 Enabling Characteristics

Enabling resources are personal or community resources, which facilitate or inhibit use of health services. A socio-economic gradient in health status is often reported in which wealthier people tend to be in better health than poorer and less-educated people (Veugelers and Yip, 2003). Explanations for this gradient include the poor having poorer lifestyle habits as well as lower use of preventive health services (Davis et al., 1981; Whitehead, 1998; Lynch et al., 1997). Research has found low income and socio-economic status to be barriers to all types of health care services (Pappas et al., 1997; Kephart et al., 1998; Fiscella et al., 2000; Yip et al, 2002; Veugelers and Yip, 2003; van Dooslaer et al., 2006). In Canada, however, the introduction of universal health care in 1984 resulted in a reduction in socio-economic disparities in health care access (Sarma and Simpson, 2006). Despite this, however, recent Canadian studies have found people of low socio-economic status to have higher physician and hospital utilization and costs (Kephart et al., 1998; Veugelers and Yip, 2003; Glazier et al., 2000).

In the cross-sectional MCP sample in our study this hypothesis was supported by a reduction in ambulatory specialist utilization and specialist costs for income quintiles Q2 through Q5 relative to the lowest income quintile in both MCP analyses, as well as a similar reduction in total physician costs for the longitudinal MCP analysis. However, this result is actually at odds with other research studies which have shown that, although lower income people are more likely to have physician contacts (Kephart et al., 1998; Veugelers and Yip, 2003;), they are more likely to do so with a primary care physician, whereas Canadians of higher socio-economic status are more likely to see specialists than lower income people (Roos and Mustard, 1997; Dunlop et al., 2000; Glazier et al., 2000; Finkelstein, 2002; Yip et al., 2002; Veugelers and Yip, 2003; van Dooslaer et al., 2006; Blackwell et al., 2009). In the Phase I (CCHS) sample of our study higher income was associated with a small reduction in ambulatory specialist visits although not with total specialists visits (Tables 4.10 and 4.11). An explanation for the observed increase in specialist use in the lowest income quintile in the MCP sample in our study may be that ambulatory specialist visits in our study included emergency room contacts for low income people while specialist visit data in other research did not. In support of this hypothesis, research has shown an increase in emergency room usage with lower income in an all-ages sample in Manitoba (Menec et al., 2005) and in a sample of people aged 65+ in Quebec (Ionesu-Ittu et al., 2007). In the current study, relationships of income with total specialist utilization and FP costs varied between the two MCP analyses and among income quintiles and, thus, were less clear.

Hospital utilization was higher for people in income quintiles Q2 through Q5 than for those in the lowest income quintile. An explanation for this may be that people in the lowest income quintile may do without health care because of the associated cost (e.g. travel costs). The Commonwealth Fund survey found that approximately 1 quarter of lower income Canadians went without health care because of cost (Schoen et al., 2004). People with very low income may not seek appropriate health care services because of lack of knowledge about health and health care need, possibly due to lower education levels, and often problems such as unemployment and inadequate housing are so overwhelming that health needs have relatively low priority (Mausner and Kramer, 1985). In line with the literature, however, number of hospitalizations was lower for higher income people in the CCHS sample (Table 4.9) and, in the MCP sample, evidence of a reduction in hospitalization for the higher income groups was present in Tables 4.19 and 4.31 given that the magnitude of difference in hospitalizations relative to the lowest quintile was slightly smaller for Q4 and Q5 than it was for Q2 and Q3

Overall, differences in health care utilization between socio-economic groups tended to be small and did not always reach statistical significance, which supports previous research suggesting that income-related differences in access to health care services in Canada are smaller relative to those in the US (Blendon et al., 2002; Schoen et al., 2004; Blackwell et al., 2009).

We also found rural-urban differences in health care services utilization. Individuals with a rural place of residence tended to have more hospitalizations and more hospitalizations for ACSCs than those with an urban place of residence, although the differences did not reach statistical significance for total hospitalizations in the longitudinal MCP analysis. Studies in Canada and Australia have shown people in rural areas to have more hospitalizations and more hospitalizations for ACSCs (Ansari et al., 2007; Laditka et al., 2009; Menec et al., 2010), while other studies in the US and Canada have shown no rural-urban differences in hospitalization (McConnel and Zetman, 1993; Himes and Rutrough, 1994). In our study, use of physician services tended to be lower in rural areas as evidenced by lower specialist utilization and costs in both MCP analysis, and by lower FP costs in the longitudinal MCP analysis. Differences did not reach statistical significance for specialist utilization in the CCHS or for FP costs in the second MCP analysis. This finding is supported by other research, which has shown people from rural areas to have fewer FP and specialists visits (Larson and Fleishman, 2003; Goodridge et al., 2010; MacDonald and Conde, 2010), while other studies have failed to show rural-urban differences (McConnel and Zetman, 1993; Himes and Rutrough, 1994). The fact that no rural-urban differences in specialist utilization were found in the CCHS may have been a result of small sample size. Findings from the current study may suggest problems with access to physician services in rural areas (Goodridge et al., 2010), which may be a result of both distance and retention of health care workers (MacDonald and Conde, 2010; Nagarajan, 2004 in MacDonald and Conde, 2010). However, the apparent lower use of services in rural areas may also be due to the fact that the percentage of salaried physicians is higher in rural areas and that the MCP claims file only includes visits to fee-for-service physicians.

Finally, in the Phase I analysis (CCHS) being physically-inactive was associated with increased hospitalization. These findings are similar to those of other research in the US, which have found physical inactivity to be associated with increased health care costs (Pratt et al., 2000; Andreyeva and Sturm, 2006).

5.3 Continuity of Care and Health Care Services Utilization

One of the main objectives of the current study was to examine the relationship of level of continuity of FP care with measures of health care services utilization (total specialist contacts, ambulatory specialist contacts and acute hospitalizations).

5.3.1 Analysis of Continuity or Care and Health Care Services Utilization Outcomes over the Same Four-Year Period

5.3.1.1 Phase I – Canadian Community Health Survey Analysis

The descriptive statistics of the Phase I sample for age 12+ (whole sample) showed that the medium continuity group tended to have the highest number of specialist contacts, ambulatory specialist contacts and hospitalizations, although differences for hospitalizations were non-significant (Table 4.6 and 4.7). As we move to the older age groups utilization levels were seen to increase with decreasing continuity level. The shift occurred at the 65+ age group for specialist contacts and at the 55+ age group for ambulatory specialist contacts and hospitalizations and patterns remained the same for the 65+ age group.

In an attempt to explain differences in health care utilization between continuity levels, we first look to relationships with co-variates in the unadjusted descriptive statistics. For age 12+ (whole sample) and the 55+ age group the medium continuity group tended to consist of a higher proportion of survey respondents from urban areas than the other two continuity groups (Tables 4.2 and M1), which may at least partially explain the higher number of specialist contacts seen at the medium continuity level in these two age groups. The increase in specialist contacts seen in the medium continuity group (relative to the other two continuity levels) is actually even greater in the 55+ age group than at the 12 + age group. This may be due to an increase in proportion of females in the medium continuity group in the 55+ age group (Table M1) who may experience menopause-related health problems, which may require increased specialist intervention. In addition, in the 55+ age group the medium continuity group has more survey respondents in the low income category and a tendency to have slightly higher percentages of people the non-partnered marital status categories (Table M1), which may contribute to the higher specialist and hospital utilization in the medium continuity group at this age group.

To further verify relationships, multivariate analyses were performed. In the multivariate analysis of the Phase I sample (CCHS) associations were found between continuity of FP care level and health care services utilization. For the whole sample (ages 12+) individuals with low and medium continuity had a higher number of total specialist contacts, and total hospitalizations relative to those with high continuity, with the difference being greater for the medium continuity group (Table 4.12) and the magnitude of these differences increased in the older age groups. Thus the relationship of continuity of care with health services utilization outcomes appeared to be non-linear.

However, as age increased, there was a shift towards a more linear relationship where number of hospitalizations and specialist visits increased with decreasing continuity level. For ambulatory specialist contacts, the low continuity group tended to have the highest number for all age groups and the magnitude of the difference became greater with age. These results are consistent with increasing continuity of primary physician care resulting in a reduction in health care services utilization and also with the idea that continuity of care is more important or has a greater effect in older people.

A possible explanation as to why the low continuity group showed less health care utilization than the medium continuity group in the whole sample (age 12+) is revealed in the descriptive statistics which show that, for the whole sample (ages 12+), the low continuity group was younger, of higher income level, and had better health status than the medium and high continuity groups as evidenced by fewer chronic illnesses (i.e. fewer respondents in the 2+ category) and fewer FP visits. Lower age, higher income and less chronic illness suggest that this group may have less need for health services while fewer FP visits means less opportunity for continuity of FP care to influence health care service levels. At higher age groups the low continuity group becomes more similar to the other two continuity groups with respect to age and chronic illness.

5.3.1.2 Phase II - MCP Cross-sectional analysis

The descriptive statistics of the cross-sectional analysis of Phase II showed that, in the 12+ age group (whole sample), the medium continuity group had the highest number of ambulatory specialist contacts, while the high-continuity group had the highest number of total specialist contacts, total hospitalizations, and hospitalizations for ACSCs (Tables 4.15 and 4.16). Ambulatory specialist contacts showed a shift in utilization patterns at the 55+ and older age groups such that number of contacts increased with decreasing continuity although differences were not significant at higher age groups. Total specialists contacts and total hospitalizations showed a shift to where the medium continuity group had the highest utilization at the 55+ age group and then to where the low continuity group had the highest utilization, although differences were not always significant. For hospitalizations for ACSCs the medium continuity group had the highest utilization for the three older age groups although differences were small and not always significant.

In looking to co-variates to explain the above health care utilization patterns, the higher service utilization in the high continuity group in the 12+ age group (whole sample) may be partially explained by a tendency for older age, lower income and a higher number of chronic conditions in this group in the sample overall (Tables 4.13). In the 55+ age group the higher health care utilization in the medium continuity group may be partially explained by a higher proportion of people from rural areas in the medium continuity group and a tendency for a higher number of chronic conditions in the low and medium continuity groups (Table M7). In the 65+ and 75+ age group respondents in the low continuity group have a tendency to be older (Tables M8 and M9), which may partially explain the increased use of health care services at this continuity level in these age groups. In addition, at the 65+ age group the people in the low continuity group also had a tendency to have more chronic conditions and at the 75+ age group the low continuity group tended to have a higher proportion of respondents living in rural areas (Tables M8 and M9).

The multivariate portion of the cross-sectional analysis of Phase II (MCP registry sample) showed similar associations between continuity and specialist contacts and between continuity and hospitalization (Table 4.23) relative to that seen in the Phase I (CCHS) analysis. Health care service utilization outcomes tended to be higher in the low and medium continuity groups than in the high continuity group and these differences tended to become greater in the older age groups. As in the Phase I analysis, a shift was seen, this time from high or medium continuity having the highest health care utilization to where utilization increased with decreasing continuity level as we moved to older age groups. This analysis also included a fourth utilization outcome, hospitalizations for ACSCs, which also showed a similar relationship with continuity. However the shift in utilization patterns did not occur for this outcome and magnitude of difference in hospitalizations for ACSCs relative to the high continuity group was slightly higher for the medium continuity group (than for the low continuity group) at all age groups. Magnitudes of differences seen were higher for hospitalizations for ACSCs than for total hospitalizations. This outcome was not used in Phase I because of its rarity and the small sample size of the CCHS.

Here in the MCP sample, however, the association between higher continuity and reduction in specialist contacts and hospitalization was not as strong as seen in the Phase I (CCHS) analysis. The reason for the decreased strength of the relationship here may be that the MCP sample is a more rural, sicker sample that the Phase I sample, and is hospitalized more and under more specialist care, as evidenced by greater number of hospitalizations and specialists contacts. Thus, given that this sample is more dependent on hospital/specialist care, continuity of FP care may be less important for this sample than for the CCHS sample who may have received more of their care in the community setting. Also, the MCP sample would most likely include some institutionalized elderly, which would not be present in the CCHS sample. The health and chronic illnesses of this population would probably be closely monitored by institutional staff (e.g. nurses), and thus continuity of care with the primary care physician may be less important for this group, this contributing to a reduction in the strength of the overall relationship of higher continuity with reduced health care utilization.

In addition, here in MCP sample, the observed shift in health care services utilization patterns in older age groups to where higher continuity was associated with decreased service utilization actually occurred at older age groups in the MCP sample than in the CCHS sample. Whereas, in the CCHS sample the shift appeared in the 55+ age group, in the MCP sample it did not become apparent until the 65+ or 75+ age groups. In trying to explain the delay in this shift in the MCP sample, let us recall that in the CCHS sample, the number chronic illnesses and FP visits in the whole MCP sample (ages 12+) was lower for the low continuity group than for the other two continuity groups. This number, however, becomes more similar to the other two groups at the 55+ age group. Thus, the lower number of chronic illnesses may partially account for why the low continuity group shows less of an increase in health care utilization than the medium group for the 12+ sample. In the MCP, however, the explanation for the shift in health care utilization patterns is not as clear as it is in the CCHS sample because the shift seen in the regressions towards increased utilization with decreased continuity level doesn't happen until the 65+ or 75+ age group and, thus, doesn't coincide to as much of a degree with the shift seen in chronic illness and age, as is the case in the CCHS analysis. The reason for the delay in the shift in utilization patterns in the MCP sample relative to the CCHS sample is unclear, but it may be partially due to differences in sample characteristics such as the MCP sample being older, more rural and more chronically ill or there may be another unknown variable or variables at play here, which are different in the low continuity group and not accounted for in the analysis.

Although, a relationship of continuity was found with hospitalization and total specialist visits in the MCP sample as it was in the CCHS sample, the relationship between continuity and ambulatory specialist contacts was not as clear in the former case. For ambulatory specialist contacts the medium continuity group had a slightly lower number of contacts than the high continuity group in the 12+ age group (whole sample), but there was no difference for the low continuity group. In the older age groups (55+, 65+ and 75+), nether the low-, nor medium-, continuity groups differed from the high-continuity group with respect to number of ambulatory specialist contacts. Thus, the relationship between continuity and ambulatory specialist visits was not as clear as for the other three utilization outcomes. The lack of a "dose-response" relationship suggests that the difference seen with the medium continuity group may have been due to the large size of the cross-sectional MCP sample. The finding that higher continuity was associated with a reduction of total specialist visits, but not ambulatory specialist visits, suggests that continuity of care may reduce hospital specialist visits but not office, outpatient or ER visits for this sample. The CCHS sample, however, did show a relationship of higher continuity with a reduction in ambulatory specialist contacts. It may be that because individuals in the MCP sample are in hospital more and thus may see more hospital specialists than those in the CCHS sample, this may reduce the relationship between continuity of care and ambulatory specialist contacts for this sample. Indeed, although the MCP sample has a higher number of both total and ambulatory specialist contacts than the CCHS sample, the difference in total specialist contacts between the two samples is much greater than that of ambulatory specialist contacts which indicates that the MCP sample is seeing more hospital specialists.

It proved difficult to make direct comparisons of our results to the literature because of differences in continuity measures, outcome measures, analysis methods, and populations studied. For example, most previous studies of continuity of primary provider and hospitalization use logistic regression to examine the relationship of continuity with the odds of hospitalization whereas we use log-linear regression to examine the relationship between continuity of FP care and number of hospitalizations. However, we make a genuine effort here to compare our results and provide as much explanation as possible.

Our results are consistent with a high level of continuity of primary care resulting in a reduction in hospitalizations (and hospitalizations for ACSCs) and specialist contacts, and also suggest that the reduction in health care utilization may be greater for older people than for younger people. Evidence for the relationship between continuity and ambulatory specialist contacts was, however, not as robust as that for the other three outcomes given that the relationship observed in the Phase II analysis was not as clear for ambulatory specialist contacts.

These findings for hospitalization are similar to the results of previous studies, which have demonstrated reductions in hospital use with increasing continuity of primary care provider. For example, in two studies of Delaware Medicaid patients, Gill and Mainous (1998) and Mainous and Gill (1998) found reductions in likelihood of hospitalization of 25% and 44% in people aged 0-64 with high continuity of primary care provider as well as a similar reduction in likelihood of hospitalization for chronic ACSCs, but they did not report the differences that were found in number of hospitalizations, if any. Cree et al. (2006) found an approximate 25% reduction in number of hospitalizations for those with higher continuity among patients with asthma over a five-year period using administrative health care datasets from Alberta, Canada. Similarly, Lin et al (2010) found a 33% reduction in hospitalizations for ACSCs in a sample of people with diabetes in Taiwan. The Taiwan study cites our previous work where we found as high as a 25% reduction in number of hospitalizations in a sample of elderly people with diabetes (Knight et al., 2009). These percentages are comparable to the results of the MCP cross-sectional analysis of the current study where we found just over a 19% increase in hospitalizations in the low continuity group relative to high continuity for the 75+ age group (Table 4.23A). In addition, Christakis et al., (2001b) found 28% and 58% percent increases in hospitalizations in children age 0-18 for those in the medium and low continuity categories relative to those in the high continuity category as well as a similar increase in emergency room visits over a 5-year period using HMO claims data in the US. In the current study, however, we found evidence of a reduction in hospitalization and specialist visits with low continuity in our lowest age group (12-19 years) in the cross-sectional analysis and no relationship between continuity and health care services utilization for this age group in the longitudinal analysis. One reason for the discrepancy in the results the current study and Christakis et al. (2001b) may be the fact that children below age 12 were not included in the study sample. Continuity of primary care provider may be most important because of childhood ailments, which would be most likely to occur at these younger ages. The difference may also result from differences in health care systems between the US and Canada.

Similar relationships between continuity and hospitalization have been documented in elderly populations. Wasson et al (1984) found a 51% reduction in emergency department admissions and a 60% reduction in hospital length of stay associated with higher continuity in men age 55 and over attending general medical clinics in the US, while Smith (1995) showed a 28% in hospital readmissions in a veterans affairs hospital in the US. Weiss and Bluestein (1996) showed a 29% reduction in hospitalizations and a 23% reduction in hospital cost with high continuity in a US Medicare survey sample, while Menec et al. (2006) found 33% reduction in likelihood of hospitalization for ACSCs (but not in likelihood of hospitalization for any reason) with higher continuity in a sample of older adults (age 67+) in Manitoba, Canada.

Menec et al (2006) argue that an explanation for why they saw an association of continuity with hospitalizations for ACSCs but not total hospitalizations was that prevention and management of chronic diseases, an important component of ACSCs, might "take on increasing importance" in older people (Menec et al., 2006). In the current study we found an association of continuity of care with both total hospitalizations and hospitalizations for ACSCs and the magnitude of the association increased with age with the strength of this relationship being stronger for the hospitalizations for ACSCs than for overall hospitalization, although hospitalizations for ACSCs did not show the clear "dose-response" relationship seen with total hospitalizations. These findings also provide evidence that continuity of care is of increased importance in older people and that the mechanism by which continuity may exert its effects is by allowing for better prevention and management of chronic illness, which would most likely be more important in the elderly given the increased prevalence of these conditions in this group. An explanation why we found an association with total hospitalization, whereas Menec et al., 2006 did not, may be that the ACSCs used in the current study were more limited to chronic illnesses than those used by Menec et al. (2006). The list which Menec reports includes 28 ACSCs, whereas the list used for the current study obtained from CIHI was limited to only 8 chronic health conditions (Canadian Institute for Health Information, 2008). For example, the list used for our study omitted respiratory infections such as pneumonia or pulmonary tuberculosis. Therefore, in the current study, total hospitalizations would most likely have included hospitalizations for other health conditions particularly sensitive to continuity of primary care, which were not included in the ACSC list for the current study, thus explaining associations found with total hospitalizations as well as hospitalization for ACSCs.

The study by Lin et al. (2010) mentioned above, examining the association of continuity of FP care on hospitalizations for ACSCs in elderly diabetics in Taiwan, actually looked at the relationship of continuity with both short and long-term hospitalizations for ACSCs using continuity tertiles similar to the continuity groups used in the current study (index values of <0.47, >= 0.47 to <= 0.75, >= 0.75). For long-term hospitalizations for ACSCs they found a somewhat linear relationship with continuity where people with medium continuity had 31.5% more hospitalizations than the high continuity group and people low continuity group had 33.6% more hospitalizations. For short-term ACSC hospitalizations however, they found a non-linear relationship similar to what we found with the full Phase I and Phase II cross-sectional samples (age 12+) where their medium continuity group had 27.6% more hospitalizations the high continuity group and their low continuity group only had 12.4 % more, but differences were not statistically significant. We also found a similar pattern in the hospitalization for ACSCs outcome for older age groups. The authors do not offer any explanation as to why the magnitude of difference in hospitalizations might be higher for the medium continuity group than for the low continuity group as found in our study. They do suggest that the reason why continuity may not have a significant effect of short-term hospitalizations is that short-term hospitalizations may "arise from any factor that produces non-compliance" which are "likely beyond the doctor's control" (Lin et al., 2010). In future, we should somehow account for length of hospitalization in our analysis in order examine it as a possible explanation as to why continuity may have a stronger effect in some situations than in others (e.g. younger vs. older people).

Our study results are also somewhat similar to another Canadian study by Reid et al. (2003) who examined the association of continuity of FP and specialist care with hospitalization in a 5% sample of the BC population consisting of all ages. Although Reid et al. (2003) did not find an association of hospitalization with FP continuity alone, they did find an association when they "included specialist visits" in their continuity measures and "attributed them back to their referring FP" (Reid et al, 2003). After doing this they found an association of continuity of care with reduced hospitalizations and found "dose response" relationships where reductions in hospitalizations became larger with increasing continuity similar to what was found in the current study with FP continuity. Unfortunately, in the current study the physician claims file did not give us the ability to link a specialist visit with the referring family physician so we were unable to duplicate this second portion of Reid's study.

Part of the reason why an association of FP continuity and hospitalization was found in the current study may be that the study period for the current study was longer than that used by Reid et al. (2003). We used a 4-year study period whereas Reid et al. examined continuity over only a one-year period and hospitalization over the one-year period following. One year may not have been a long enough time to demonstrate an association. Another explanation may be that continuity of care may be especially important in preventing hospitalizations and/or other health care utilization at times just before a health condition becomes serious, or just before an acute exacerbation of an illness, and in order to show an association of continuity of FP care with hospitalization (i.e. implying that good continuity prevents some hospitalization) it may have been necessary to incorporate a sufficient number of FP visit and hospitalization events, which occurred in close proximity to one another, into the analysis. For example, two or more consecutive visits where a patient saw the same physician may have prevented an impending hospitalization, while for another patient several FP visits where the patient had poor continuity, may have failed to prevent a hospitalization shortly thereafter. Measuring continuity and hospitalization each over separate time periods, as Reid et al. (2003) may have introduced an artificial disconnect between the two time periods which prevented incorporation of physician and hospitalization events in close proximity to one another into the analysis and thus no association was detected. Also, continuity of care levels may have been different in the period in which continuity was measured versus that in which outcomes were measured.

In the Reid et al. (2003) study, accounting for referral back to the appropriate FP may have resulted in an association emerging because of appropriate referral by FPs of patients to medical specialists with the appropriate skills to treat and manage complex chronic illness as well as good information transfer between FPs and specialists. The patients involved in these cases were probably older and sicker, and thus, perhaps required less time for continuity of care to make a difference to hospitalization outcomes. This may be taken as being similar to the results of the current study where we demonstrated that continuity became increasingly important in reducing hospitalizations with increasing age. In addition, Reid et al. (2003) did not conduct analyses for separate age groups. If they had done this they may have noticed emergence of a significant association between continuity of FP care appearing at higher age groups, which was not present in the analysis for the whole sample.

There have also been a small number of studies, which found no association of continuity of care with hospitalizations. For example, Gill et al. (1997) found no difference in likelihood of total hospitalizations or hospitalizations for ACSCs between Delaware Medicaid patients aged 0-64 with and without a regular source of primary care. Although, they provide no clear explanation for this lack of association, the authors did find an association of higher continuity of care with reduced hospital length of stay, which provided evidence that individuals with higher continuity may be less like to be hospitalized with more serious illness. Wasson et al. (1984) also found continuity of care to be associated with shorter hospital length of stay in the absence of an effect on overall hospitalization rate in a group of men age 55+ in a Veterans Administration clinic.

Overall, the results of CCHS and MCP cross-sectional utilization analyses, one using the provincial sample of a national health survey and the other using a sample from the provincial health insurance registry (Phase I and the cross-sectional analysis of Phase II) have shown continuity of FP care to be associated with a reduction in number of total hospitalizations and hospitalizations for ACSCs, a result which is similar to most other research in the area.

The results of the current study are also similar to studies, which have shown an increase in number of specialist visits with lower continuity in primary care (Starfield et al., 2009; Joffe et al., 1999; Raddish et al., 1999; Heagarty et al., 1970). Using insurance claims spanning a one-year period, Starfield et al. (2009) found that discontinuity of primary care physician (i.e. lower FP continuity) was associated with an 8% increase in number of ambulatory specialist visits in a sample of non-hospitalized individuals, an increase which became greater with age. The larger magnitudes of increase in specialists visits seen in the elderly in our study (65.2 % for the CCHS and 17.5 % for the cross-sectional MCP sample) (Tables 4.12B and 4.23C) may be due to the inclusion of people who were hospitalized during the study period who would have been sicker and thus had more specialist contacts both in and out of hospital, a group which was excluded from the study by Starfield et al. (2009). Continuity of FP care may be more important for people in this group given that they would be sicker and thus most likely have more serious chronic illnesses which may have required an increased rate of specialist referral.

Using US Medicaid claims, Joffe et al. (1999) found an increase in number of specialist and emergency department visits for children (aged 0 to 16) who switched primary provider site or physician group. Children who sought care from more than one primary care site or physician group had about three times as many specialist visits as those seeking care from a single site (0.99 vs. 0.31 visits per year). In the current study, however, there were no differences found in specialist utilization for the youngest age group (12-19 years). Explanations for the lack of an association between continuity and specialists visits in the 12-19 age group in the current study relative to that found by Joffe et al. (1999) include that the current study sample lacked children under 12, the group where continuity of FP may be especially important for children due to occurrence of childhood ailments as well as that the two studies were done in different health care systems. Also, the sample used by Joffe et al. (1999) was low income Medicaid patients. Given the association of low income with poorer health status, continuity of care may be more important for this population and thus we may see a stronger association of continuity with specialist visits, or emergence thereof. Indeed, it has been previously found that the association of higher continuity with reduction in emergency room visits and hospitalizations is stronger in children on Medicaid (Chistakis et al., 2001b). Although there was no association of continuity with specialist contacts found in lower age groups in our study, associations were found in older age groups. For example, in the 65+ age group, number of specialist visits over a four-year period was higher in the low continuity group vs. the high continuity of care group (7.85 vs. 7.17) amounting to a 10 % difference in the multivariate analysis. These results are supported by a study of US patients with selected chronic illnesses by Raddish et al. (1999) who found that patients seeing a higher number of primary health care physicians saw more specialists and had higher associated pharmacy costs, as well as by a study of patients in a US paediatric care program by Heagarty et al. (1970) who demonstrated an association of improved continuity of care with a reduction in specialist referrals.

However, in the current study the relationship between continuity and ambulatory specialists visits was not as clear as that seen in US studies by Starfield et al (2009) and Joffe et al., above. This discrepancy may be due to differences in health care systems in Canada and the US. In Canada a referral from an FP is normally required to see a specialist, whereas this is not necessarily so in the US. In the US an association of lower continuity of care with self-referral of patients to specialists has also been documented

(Forrest et al., 2001), which may partially explain the observation of an association of higher continuity with a reduction in ambulatory specialists contacts observed in the US studies, which was not as clear in the MCP (Phase II) analysis of our study. An association of higher continuity with a reduction in ambulatory specialists visits was, however, observed in the CCHS (Phase I) analysis of our current study, which suggests that the presence of such an association may depend on specific circumstances such as the seriousness the patient's health condition, or population factors such rural/urban status or health status, physician characteristics, or many other possible factors. These details cannot be obtained from the administrative data sources used in the present study.

In summary, overall in the present study, continuity of care has been shown to be associated with a reduction in specialist utilization, a result similar to that found in the small number of previous of studies on this topic. As Starfield et al (2009) stated, low continuity of primary care provider is likely to be associated with "increased unfamiliarity with patients, greater uncertainty and great tendency to refer" [patients] to specialist care.

5.3.2 Analysis of Continuity of Care over a Two-Year Period and Outcomes over the Following Two-Year Period: Phase II - Longitudinal analysis

As was previously stated, the findings thus far are consistent with the possibility that a higher level of continuity of care is responsible for a reduction in hospitalization and specialist contacts. However, given the cross-sectional nature of Phase I and the cross-sectional analysis of Phase II, where both continuity and outcomes were measured over the same four-year period, one cannot be certain that it is actually continuity of care, which is driving the observed reduction in health care utilization. It may be that individuals who have high hospitalization rates and/or specialist utilization, "being sicker as evidenced by a higher number of chronic conditions, may be more likely to visit a doctor's office with urgent problems and find themselves having to see an unfamiliar provider as a result, perhaps because their regular doctor is not available" (Knight et al., 2009). Indeed, research has shown that patients may not be willing to wait to see their regular physician for acute illness (Freeman and Richards, 1994; Love and Mainous, 1999). Alternately, it could be that patients with good outcomes are happier with their health care and choose to maintain a more consistent relationship with their primary health care provider than people with poorer health outcomes, or thirdly, perhaps continuity of care is associated with other variables not accounted for in our study, which are more closely related to better health outcomes (Saultz and Lochner, 2005).

Because of the uncertainties outlined above, a longitudinal analysis of the phase II sample was conducted where continuity was measured over the first two years of the 4-year period (1999-2000) and outcomes were measured over the last two years (2001-2002). If similar results to the above analyses were obtained using this more longitudinal design, this would provide stronger evidence that it was actually the existence of good continuity beforehand, which drives a reduction in hospitalization and/or specialist contacts as time goes on.

As was previously stated the longitudinal sample was slightly older and sicker than the cross-sectional sample as evidenced by a greater number of chronic illnesses, FP visits and specialists contacts. The results for the longitudinal analysis of the Phase II sample, however, were not as predictive as those of the cross-sectional analysis. In the descriptive portion of the analysis for all utilization outcomes there was a tendency for the medium continuity group to have the highest utilization for all outcomes for almost all age groups (Tables 4.29 and 4.30). These utilization patterns may be partially explained by the medium continuity group tending to have a higher number of chronic conditions for the 55+, 65+ and 75+ age groups and a tendency and tending to have a higher proportion of people from rural areas for the 65+ and 75+ age groups (Tables M14-M16).

In the multivariate portion of the longitudinal analysis the medium continuity group tended to have slightly higher total hospital and specialist utilization than the high continuity group while utilization for the low continuity group did not differ from that of the high continuity group (Table 4.35). The significant difference seen with the medium continuity group may simply have been due to inflated type I error due to making multiple comparisons. There were few differences for ambulatory specialist visits at the higher age groups, and for the 75+ age group, there was no difference in utilization for total hospitalization or the two specialists outcomes. However, the pattern seen for hospitalizations for ACSCs was similar to that seen in the cross-sectional analysis where both the low and medium continuity groups had a greater number of hospitalizations than the high continuity group, a trend which became more pronounced with age. There was also a shift that occurred between the 65+ and 75+ age groups from where the medium-continuity group had the most hospitalizations for ACSCs to a relationship where hospitalization for ACSCs increased with increasing continuity (i.e. "dose-response" relationship)

As explained earlier, an explanation for the lack of association seen with the other three outcomes at the 75+ age group may due to the fact that the MCP sample would most likely include institutionalized elderly which would tend to be 75 and over. The health of these people would probably be more closely monitored and kept under control by institution staff (e.g. nursing staff) and thus continuity of FP care may not be as important for this group, which may serve to explain the lack of association in this age group.

Thus, overall in the longitudinal analysis, there was evidence for a relationship where higher continuity of FP care was associated with a reduction in hospitalization for ACSCs, a relationship which grew stronger with age and demonstrated a "dose response" relationship at the 75+ age group. No clear relationship was seen between continuity and the other three health care service utilization outcomes.

The results of the above Phase II longitudinal analysis are consistent with that of Menec et al., (2006) who also demonstrated an association of higher continuity of primary care physician with hospitalizations for ACSCs but not with total hospitalizations. These researchers also used a longitudinal study design where continuity was measured at an earlier time period than outcomes as in the longitudinal analysis in the current study.

The lack of association found here between continuity and total hospitalizations is similar to the lack of an association between FP continuity and hospitalization found in a

B.C. sample by Reid et al. (2003) and in a Delaware Medicaid sample by Gill (1997). Reid et al. did not examine the relationship of continuity with hospitalizations for ACSCs as in the current study. An explanation for the lack of an association may be the relatively short time frames of the three studies. Reid and Gill looked at continuity over only one year and outcomes over the following year whereas the longitudinal analysis of phase II in the current study examined continuity over a two-year period and outcomes over the following two years. These periods may not have been long enough to capture care patterns which demonstrate a large enough association of continuity and total hospitalizations/specialist contacts. The reason why an association of continuity of care with reduced hospitalizations for ACSCs was demonstrated in the current study may have been that the longer two-year time period may have been required to demonstrate such an association.

Another explanation for the lack of an apparent association between continuity and utilization measures, other than hospitalization for ACSCs, may be that in order for such an association to be detected the analysis must capture FP visit and hospitalization events which are in close proximity to one another, and this would be less likely when continuity and outcomes are measured over different two-year time periods. Measuring continuity and outcomes over two different time periods may introduce an artificial disconnect between FP care patterns and outcomes, which may prevent demonstration of an association between continuity and outcomes.

Previous studies examining the association of continuity with specialist visits examined the two variables over the same time period. For the association between continuity and hospitalization some studies examined both variables over the same time period while others measured continuity during an earlier period than when hospital outcomes were measured, although few of the studies explicitly state their logic in doing so. Gill and Mainous (1998) state that their reason for measuring continuity during one year and outcomes during the following year was to investigate impact of continuity on future hospitalizations.

As a final point, recall that Reid et al. (2003) did find an association with a reduction in hospitalization after incorporating specialist visits and accounting for the referring primary care provider. It would be interesting to examine the incorporation of specialist continuity into the current study while accounting for the referring provider, in order to see if an association with health care utilization would emerge, but as was previously stated, the physician claims file for Newfoundland and Labrador does not allow for this.

5.4 Continuity of Care and Cost of Health Care Services Utilization

Analyses of health care services cost were conducted for each of the two Phase II analyses using the same predictor variables used for the utilization analyses. Cost outcomes were: cost of FP visits, specialist visits, total physician visits and hospital separations. Hospital cost, in particular, allows us to paint a better picture of the seriousness of health conditions given that costs are adjusted for expected length of stay based on the most-responsible diagnosis, co-morbidities and age.

5.4.1 Phase II (MCP Sample) Costs - Cross-sectional Analysis

In the descriptive portion of the cross-sectional analysis the high continuity group showed the highest FP cost for all age groups (Table 4.38). As seen previously with the total specialist and hospital utilization measures, for the 12+ age group (whole sample) the high continuity group showed the highest specialist and total physician costs (Table 4.38) as well as the highest hospital costs (Table 4.39). Specialist and total physician costs showed a trend very similar to that seen previously with total specialist utilization, where the medium continuity group had the highest costs for the 55+ and 65+ age groups and the high continuity group and had the highest costs for the 75+ age group. Hospital costs showed a very similar trend to that for hospital utilization where the medium continuity group had the highest costs for the 55+ age group and the low continuity group had the highest costs for the 65+ and 75+ age groups.

In looking to co-variates to explain the above health care cost patterns, we use the same arguments as used previously with utilization patterns. In the 12+ age group (whole sample), the higher health care costs in the high continuity group may be partially explained by a higher proportion of people in this group who are older and of lower income combined with a higher average number of chronic conditions (Table 4.13). In the 55+ age group the higher health care costs in the medium continuity group may be partially explained by a higher proportion of people in this group being from rural areas (Table M7). In the 65+ and 75+ age group respondents in the low continuity group have a tendency to be older (Tables M8 and M9), which may partially explain the increased health care costs at this continuity level in these age groups. In addition, for the 65+ age group people in the low continuity group have more chronic conditions and in the 75+ age group the low continuity group has a higher proportion of respondents living in rural areas (Tables M8 and M9).

The higher FP costs seen in the high continuity group across age groups may also be partially explained using co-variates. For the three lower age groups the high continuity group has a higher proportion of patients in the lowest income quintile, for the 12+ and 75+ age groups the high continuity group tended to be older and have a high number of FP visits, and finally, for the 12+ age group the high continuity group tended to have a higher number of chronic conditions (Tables 4.13 and M7-M9).

The higher hospital cost for hospitalized patients in the medium continuity group is difficult to explain using co-variate relationships in the 12+ age group (whole sample). For the three upper age groups some explanation for health care cost patterns can be drawn from observation of co-variates. For the 55+ and 65+ age groups, the medium continuity group has a higher proportion of people living in rural areas, for the 55+ and 75+ age groups the medium continuity group has a higher proportion of people with 2 or more chronic conditions while in the 75+ age group the medium continuity group has a higher proportion of people in the lowest income category (Tables M7-M9).

In the multivariate portion of the cross-sectional analysis, for the whole sample (ages 12+) FP cost was slightly higher in the medium continuity group relative to the high continuity group, but there was no corresponding difference for the low continuity group. At the 55+, 65+ and 75+ age groups neither the medium nor low continuity groups differed from the high continuity group with respect to FP cost (Table 4.46). For specialist cost there was a shift from medium continuity being associated with the highest cost, to a situation where cost increased with decreasing continuity level at the older age groups, mirroring the results in the first (cross-sectional) utilization analysis of Phase II for specialist contacts. Total physician costs showed a similar pattern except that the shift occurred at a slightly older age group. For hospital cost there was a similar transition with age from no difference between continuity groups to where cost increased with decreasing continuity. Overall, however, low and medium continuity groups were not always significantly different from high continuity as they were for the analysis of health care services utilization previously described and thus the "dose response" relationship was not as strong for cost as it was for utilization, albeit the magnitudes of regression estimates were in the correct pattern.

5.4.2 Phase II (MCP Sample) Costs - Longitudinal analysis

Health care costs per person were about 5 to 7 % higher in the longitudinal analysis than would be expected based on dividing the values of the cost outcomes obtained in cross-sectional analysis (for ages 12+) by 2 to account for the shorter data collection period (i.e. 2 years in the longitudinal analysis vs. 4 years in the cross-sectional analysis). This was true of all cost outcomes (Tables 4.38 and 4.49). This, combined with a higher number of chronic conditions suggests that the longitudinal sample was a sicker sample than cross-sectional analysis in addition to being older.

In the descriptive portion of the longitudinal analysis FP cost was highest in the high continuity group for all age groups (12+, 55+, 65+ and 75+), while hospital cost was highest in the medium continuity group for all age groups (Table 4.49 and 4.50). Specialist and total physician costs tended to be highest in the high continuity group for the 12+ and 75+ age groups and highest in the medium continuity group for the 55+ and 65+ age groups. Differences tended to be small and not always statistically-significant.

In looking to co-variates to explain these health care cost patterns, as seen previously with the utilization analysis, the increased health care cost seen in the medium continuity group may be partially explained by patients in the medium continuity group having a higher number of chronic conditions in the 55+, 65+ and 75+ age groups and a higher proportion of people living in rural areas in the 65+ and 75+ age groups (Tables M14-M16). The only information from co-variates which offer an explanation for FP cost being higher in the high continuity group are that in the 12+ age group (whole sample) the high continuity group tended to be older, to have a higher proportion of people in the lowest income category, and a higher number of chronic conditions, and that in the 65+ age group the high continuity group tended to have a higher number of FP visits (Tables 4.25 and M15).

In the multivariate portion of the longitudinal analysis, examining continuity over a two-year period and cost over the two years following, FP cost reductions were seen for the medium-continuity group at the 12-19 age group, and for the low-continuity group for the 45-64 and 75+ age groups (Table 4.57). There were no differences in specialist or total physician costs between continuity groups. For hospital costs, the low continuity group showed cost increases for the whole sample (age 12+) as well as an increase of greater magnitude for the 45-64 age group. At these two age groups a "dose-response" relationship was seen where the cost increase seen in the medium-continuity group (relative to high continuity) was smaller than that seen for the low-continuity group, but differences for the medium-continuity group were not statistically significant. There were no corresponding differences in cost seen at the two highest age groups. Thus, in the longitudinal analysis, there was no evidence that continuity of care was associated with a cost change for specialists or total physician costs but evidence that continuity of care resulted in a reduction in hospital cost persisted.

Reductions seen in FP cost in the low continuity group in the longitudinal analysis of Phase II (Table 4.57) may be partially explained by the finding that the low continuity group was associated with a lower number of FP visits than the medium or high continuity groups for the age groups involved. The number of FP visits in the low continuity group was especially low in the 75+ age group where the largest cost reduction is seen. However, given that number of FP visits is controlled for in the analysis, there seems to be an effect of lack of continuity in reducing FP costs, which is independent of the number of FP visits. In support of this finding, Hjortdhal and Borchgrevink (1991) did report higher interpersonal continuity to be associated with lower prescribing in some instances, but overall most research suggests that continuity of FP care is associated with reductions in duplication of work done by doctors and/or decreased resource use including diagnostic tests and prescribing, as well as reductions in FP cost (Heagarty et al., 1970; Breslau and Reeb, 1975; Breslau and Haug, 1976; Starfield et al., 1976; Hjortdahl and Bochgrevink, 1991; Hollander et al., 2009).

Overall, the cost reductions observed with higher continuity of FP care results in our study are supported by studies which have found higher continuity to be associated with reductions in health care costs and proxy measures thereof. A number of studies have found higher continuity of primary care provider to be associated with reductions in health care service utilization measures (i.e. proxy measures of health care cost) and state that the observed reductions would most likely translate into cost savings for the health care system. Continuity-related reductions in emergency room visits, hospitalizations, hospital readmissions and length of hospital stay have been found in pediatric, adult and elderly populations (Christakis et al., 1999; Christakis et al., 2001b; Gill, 1997; Gill and Mainous, 1998; Mainous and Gill, 1998; Gill et al., 2000; Menec et al., 2006; Sweeney and Gray, 1995; Smith, 1995 Wasson et al., 1984; Weinberger, 1996). Studies have also found higher continuity of care and knowledge of patient history to be associated with reductions in laboratory and x-rays tests, prescriptions, and specialist visits and referrals (Heagarty et al., 1970; Hjortdahl and Borchgrevink, 1991; Starfield et al, 2009; Joffe et al., 1999). One author suggests that "not only can a physician who knows his patients provide more personal and humane care, but he can also do it more cheaply" (Heagarty et al., 1970).

Furthermore, the results of the current study are similar to studies of continuity of primary care provider and actual health care cost measures, mostly in the US and Europe, which have shown continuity of care to be associated with reductions in costs, although the different measures of continuity and cost used make direct comparison difficult. Starfield et al. (2009) demonstrated an association of lower continuity of care with increased specialist visits in a non-hospitalized US population and showed that with each additional specialist seen, specialist costs increased by $684 and total health care costs increased by $747 per person per year. Two studies showed continuity to be associated with reduced total health care costs, including specialist and hospital costs. De Maeseneer et al. (2003) showed higher provider continuity with a family physician to be associated with a 10.5% reduction in overall health care costs in an analysis of health insurance records in Belgium, while Cornelius (1997) found higher continuity of care to be associated with a one-third reduction in total health care costs in a US sample using data from the 1987 National Medical Care Expenditure Survey. Cornelius (1997) found that, specifically, continuity was associated with reductions in costs of dental services, prescriptions, physician visits and hospitalizations.

Mitton et al. (2005) found that being in the highest continuity of care quartile was associated with a one-third reduction in psychiatric hospital costs relative to the lowest continuity of care quartile for people with severe mental illness in Alberta, Canada, while Weiss and Blustein (1996) found patients with the ten or more years duration of ties with a primary care provider to be associated with a reduced likelihood of hospitalization, a 23% reduction in hospital costs and a 22% reduction in medical costs relative to patients with less than one year of ties. Raddish et al. (1999) found that US patients with selected chronic or acute health conditions seeing a higher number of primary care physicians saw a greater number of specialists and had higher pharmacy costs. Finally, a Canadian study similar to ours, using administrative health data in British Columbia, found that in patients with diabetes or congestive heart failure, higher continuity of primary care practice was associated with reduction in total health care costs, a reduction which was mainly due to a decrease in hospital costs (Hollander et al., 2009).

In summary, an analysis of continuity of care and health care costs over the same four-year period (cross-sectional analysis) showed an association of higher continuity of care with reductions in specialist, total physician and hospital costs which is similar to the literature, and the association became stronger with increasing age. In a more longitudinal analysis, where continuity was measured over a two-year period and cost outcomes measured over the following two years, no association of was found between continuity and physician costs, but an age-specific association of higher continuity with reduced hospital cost persisted. Evidence that continuity is associated with a reduction in hospital cost is especially strong given that the association was found in both the 4-year cross-sectional analyses and the longitudinal analysis. Evidence of FP cost decreases with low continuity was also found.

5.5 Comparison of Utilization and Cost Analyses – Phase II

In comparing the results of the Phase II utilization and cost analyses, for the cross-sectional analysis the results for health care utilization and cost outcomes were in the same direction, showing an overall decrease in both specialist and hospital utilization and costs with increasing continuity at older ages. In the longitudinal analysis there was no clear relationship of continuity demonstrated for either specialist utilization or costs. For hospital outcomes, however, while there was no relationship of continuity observed with total hospital utilization in the longitudinal analysis, higher continuity was found to be associated with reductions in both hospitalizations for ACSCs and hospital costs. Thus, evidence that it is continuity of care continuity which is causing the observed change in outcomes is strongest these two outcomes, given that these were the only outcomes which showed an association with higher continuity in both the cross-sectional and longitudinal analyses. This evidence also suggests that the benefits continuity of FP may be related to prevention/management of chronic illness. The hospital cost reduction seen in the longitudinal analysis, however, appeared to be limited to the 45-64 year age group. Explanations for these findings are provided in the next section, which summarizes the effects of age on the relationship of continuity of care with health care utilization and costs.

The answer to the question of why, in the longitudinal analysis, we observed an association of higher continuity with lower hospital cost, but not with lower total hospital utilization, may be that continuity is mainly responsible for reductions in hospitalizations for the chronic illnesses included the hospitalizations for ACSCs outcome. It may also be that continuity of care is the responsible for reductions in length of hospital stay rather than reductions in total hospitalization rates. In the utilization analysis we are simply counting hospitalizations and not taking the length of hospital stay into account. Continuity may allow for better problem recognition (Becker et al., 1974a; Gulbrandsen et al., 1997), which, in many situations may allow for prevention of hospitalization such as in the Phase I and Phase II cross-sectional analyses. Here in the longitudinal analysis, however, it may be that continuity may allow for patients to be hospitalized in a less serious state, which would reduce length of stay. This may involve a significant cost reduction to the health care system in addition to that seen with the observed reduction in hospitalizations for ACSCs. Evidence in support of this theory comes from Wasson et al. (1984) who suggest that continuity may reduce length of stay even when it does not reduce hospitalization rates (Gill and Mainous, 1998). Indeed Gill (1997) found that, although a regular source of primary care was not associated with a reduction in likelihood of hospitalization in sample of US Medicaid patients, it was associated with a 35% reduction in hospital length of stay and Wasson et al (1984) found a 60% reduction in length of stay in those with high continuity a sample of men 55 years and older attending a veterans' affairs clinic with no corresponding reduction in utilization.

That fact that higher hospital cost may indicate longer length of hospital stay may also be used to offer an explanation as to why the association of higher continuity with a reduction in specialist contacts demonstrated in the cross-sectional analysis (and Phase I analysis) was not seen in the longitudinal analysis. As mentioned previously, per-person hospital costs were higher in the longitudinal analysis than in the cross-sectional analysis (and Phase I analysis). Thus, the amount of time spent in hospital may have been higher as well. This, combined with the higher amount of specialist care in the longitudinal sample, may have decreased the importance of FP continuity for these individuals thus providing a possible explanation why an association between FP continuity and utilization was not seen in this sample like it was in the cross-sectional and Phase I samples.

5.6 The Effect of Age on the Relationship of Continuity of Care with Health Care Services Utilization and Costs

All analyses in the study were performed by age categories (e.g. ages 12+, 55+, 65+, 75+, etc.) in order to examine the effect of age on the relationship of continuity of FP care with health care services utilization and associated costs. As previously stated, in Phase I, for the whole sample (ages 12+), the medium continuity level was associated with the highest specialist and hospital utilization over a four-year period, but as we moved towards older age groups there was a shift towards a "dose response" relationship where health care services utilization increased with decreasing continuity level, a trend which became more pronounced at higher age groups. A similar trend was seen in the four-year cross-sectional analysis in Phase II, although associations between continuity and health care service measures were somewhat weaker. The reduction in hospitalizations for ACSCs became especially large at older age groups providing evidence for the "increased importance" of chronic illness prevention and management in older people (Menec et al., 2006). Yet another similar trend was found for continuity of care and specialist, total physician and hospital costs, in an analysis of the first (4-year) Phase II sample, a trend which, as with utilization, became more pronounced at older age groups. The FP cost reduction seen in the low continuity group in longitudinal analysis of Phase II was also greatest in the oldest age group.

In order to investigate whether it was actually continuity that was driving the observed change in health care services and the stronger relationship between continuity and health care services and cost seen with age in the four-year analyses, longitudinal analyses of utilization and cost were conducted using the Phase II sample where continuity was measured over a two-year period and outcomes were measured over the two-year period immediately following. In this analysis, there were no clear relationships observed with specialist or total hospital utilization or with specialist or total physician costs. There was a "dose-response" relationship seen where higher continuity of FP care was associated with a reduction in hospitalizations for ACSCs which became greater with age as well as with a reduction in hospital cost for the whole sample (age 12+) and for the 45-64 age group where the low continuity group was associated with an increase in cost relative to high continuity. The differences in hospital cost seen with low continuity for the 45-64 age group was about twice that seen with the whole sample (13.5% vs. 26.2%) suggesting a stronger effect of continuity in reducing hospital cost with increasing age, although significant differences between continuity group were not seen at the two highest age groups.

Appearance of the association of continuity with a reduction in hospital costs in the 45-64 age group is consistent with the literature, which shows an increase in prevalence of chronic illness at this age group, and which emphasizes the increased importance of a regular FP and good continuity of care leading up to and during these ages in order to prevent, diagnose, treat and manage chronic illness. For example, cardiovascular disease rates show increases in men at approximately age 45 and about 10 years later in women, after they have gone through menopause (Lorenzo et al., 2007). The increase in women at this age may be due to decline in ovarian hormone levels in the menopausal years (age 45-54), which may protect against atherosclerosis (Perez-Lopez et al., 2010). Type 2 Diabetes also shows a rapid increase in prevalence after age 45 (Walker and Peterson, 2010).

In addition, cardio-respiratory fitness has been found to decline at an accelerated rate after age 45 (Fleg et al, 2005; Jackson et al., 2009), thus, making it more likely for people to develop hypertension (Carnethon et al, 2003; Barlow et al., 2006), diabetes (Barlow et al., 2006; Katzmarzyk et al., 2007), metabolic syndrome (Barlow et al., 2006; Laaksonen et al., 2002; LeMonte et al, 2005) and to have higher overall mortality rates (Kampert et al., 1996; Gulati et al., 2005), death rates due to cardiovascular disease (Blair et al., 1996; Myers et al., 2002) and cancer (Kampert et al., 1996; Evenson et al., 2003), as well as increased disability/loss of independence (Jackson et al., 2009). Given that physical activity, normal BMI and not smoking are associated with better cardiorespiratory health, this indicates that good continuity of care with a regular FP to promote these healthy behaviours in patients leading up to and during these ages may result in a reduction in hospital cost at this age group as seen in the present study (Jackson et al. 2009).

The lack of a difference seen in the higher age groups may also be due to their smaller sample size (Appendix M). The 45-64 age group where the significant cost reduction was seen had a sample size of over 13,000 (exponentiated beta value (β): 1.262; 95% confidence interval (95% C.I.): 1.007-1.582), whereas the 65-74 and 75+ age groups only had sample sizes of just over 4000 (β: 1.071; 95% C.I.: 0.756-1.517) and 3000 (β: 1.177; 95% C.I.: 0.845-1.639), respectively and accordingly wider confidence intervals. Another factor contributing to the lack of association seen in the two older age groups, and especially the 75+ age group, may be the presence of institutionalized seniors in the sample for whom continuity of FP care may not be as important as in the community elderly, given that the health of this population would most likely be more closely monitored and managed by institutional staff.

Overall, the results of the study are consistent with a stronger effect of continuity of FP care in reductions in health care service utilization and costs with increasing age. These findings are similar to a recent study where discontinuity of primary care physician was found to be associated with increases in non-hospital specialist utilization and associated costs, increases which were larger for older people (Starfield et al., 2009). Similarly, Hollander et al. (2009) found that hospital and medical cost reductions seen with higher continuity of primary care practice were greater in older people. Also, the association of continuity of care with larger hospital cost reduction in older people found in our study is consistent with the results of Gill (1997) and Wasson et al. (1984). While Gill (1997) demonstrated that high continuity was associated with a 35% reduction in hospital length of stay in a sample of ages 0-64 years, Wasson et al (1984) showed that a larger reduction in length of stay of 39% was associated with high continuity in an older population of men ages 55 and over.

The results are also consistent with the results of other studies, which have found increased value of continuity of care in older people (Nutting et al., 2003; Kearley et al., 2001). For example, Nutting et al. (2003) found very old people and very young people as well as the very sick to place more value on continuity of primary care provider in a survey sample while Kearley et al. (2001) found that older people were more likely to report receiving care from a personal general practitioner. Evidence that it is actually continuity that is driving the reduction in health care services use and cost, and the strengthening of this relationship with age, evidence would have been stronger had all outcomes shown an association of continuity in the longitudinal analyses (second utilization and cost analyses of Phase II). Evidence that continuity is causing the cost reduction and the observed age effect is strongest for hospitalizations for ACSCs and hospital cost given the persistence of the relationship between continuity and these outcomes in the longitudinal analysis, although no significant relationship was evident between continuity and hospital cost at the two highest age groups.

The study results for the four-year analyses showed associations of higher levels of continuity of care with reductions in specialist contacts, hospitalizations and hospitalization for ACSCs as well as in specialist, total physician and hospital costs - associations which became stronger with age. In a more longitudinal analysis, where continuity of care was measured over a two-year period and outcomes over the following two years, clear associations were seen only between higher continuity and reductions in hospitalizations for ACSCs and hospital costs. The reduction in hospitalizations for ACSCs associations became stronger with age. An association of continuity with hospital cost did persist which showed some evidence of increasing with age, although no association was present at the two highest age groups. Reductions in hospitalizations for ACSCs were larger than those observed with total hospitalizations, which suggest that continuity of FP care may exert its benefits via improvements in prevention/management of chronic illness which may have "increased importance" in older people (Menec et al., 2006). Overall, the observed increased importance of continuity of care with age was consistent with the small amount of available literature on this topic.

5.7 Summary and Interpretation of Overall Results

Continuity of FP care was found to be an important predictor of health care services utilization. Overall, the current study demonstrated associations of higher continuity of FP care with specialist and hospital utilization and with specialist, total physician and hospital costs in cross-sectional analyses of survey and provincial health insurance registry samples and associations became stronger with age. More longitudinal analyses of the registry sample showed higher continuity to be associated with reduced hospitalizations for ACSCs and hospital costs but no clear association of continuity with specialist or total hospital utilization or with specialist or total physician costs. The association of continuity with hospitalization for ACSCs and hospital costs showed evidence of becoming stronger with age, but no continuity-hospital cost association was found in the two oldest age groups. The explanation for the lack of an association in the two older age groups may be related to sample size as well as the likely inclusion of institutionalized elderly in the sample. Given that the health of this group would most likely be closely monitored and managed by institutional staff and thus, continuity of FP care for this group may be less important than for their community elderly counterparts.

The overall results of the study are similar to the majority of literature in the area, which has shown higher continuity of care to be associated with reductions in hospitalizations and associated costs and with specialist utilization and associated costs as previously described. Results of the current study, which suggest that associations of higher continuity with reduced health care utilization and costs tend to get stronger with increasing age, are also similar to the literature (Wasson et al., 1984; Gill, 1997; Starfield, 2009; Hollander et al., 2009). The results of our study are also consistent with studies which have shown that the elderly place higher value on continuity of FP care than younger people (Nutting et al., 2003; Kearley et al., 2001).

However, given the lack of association of continuity of care with specialist and total physician contacts and associated costs in the longitudinal analysis, the possibility that it is simply a case of sicker people having more specialist care and also needing to see their FP more often, and thus having to see different FPs, as a result, cannot be ruled out. It may also be that people with better health outcomes tend to happier with their care and maintain a more consistent relationship with their FP, or perhaps there are one or more additional variables associated with both higher continuity of care and lower specialist utilization/costs, which are not accounted for in our models.

There is, however, stronger evidence for an association of higher continuity with a reduction in hospitalizations for ACSCs and hospital costs given the association demonstrated in both the four-year cross-sectional analysis and the second more longitudinal analysis. The finding that higher continuity was associated with a reduction in hospitalizations for ACSCs in both the cross-sectional and longitudinal analyses but was associated with a reduction in total hospitalization in the cross-sectional analysis only is consistent with continuity of care playing a role in or causing the observed reduction in ambulatory-care-sensitive chronic illnesses. The association of higher continuity with reduced total hospitalization observed in the cross-sectional analysis, similar to the association seen with specialist contacts/costs described above, may be due to either sicker people tending to have a need to see their FP frequently and seeing unfamiliar providers as a result, or perhaps a tendency of healthier people to be satisfied with their FP and more likely to stick with him or her.

Other explanations for the lack of a relationship being observed in the longitudinal analyses (and thus lack of any age-related effect), as discussed above, which may apply to specialist contacts and specialist/total physician costs in particular, include the timeframe not being long enough to observe a relationship (i.e. only two years for each of continuity and outcomes), or that by measuring continuity and outcomes at two different time periods may introduce an artificial disconnect which may prevent discernment of a relationship which requires relating continuity and outcome events which may be happening in close proximity to one-another. Thus, it may be that the strongest relationship between continuity and specialists contacts/costs exists in the short-term (e.g. less than a year). Indeed, the few studies which have examined the relationship of continuity with specialist visits have been cross-sectional in design where continuity and outcomes were measured over the same time period as well as conducted over a relatively short period. For example, Starfield et al. (2009) demonstrated an association of low continuity with increased specialist utilization and costs over a one-year period. The relationship between continuity of care and hospital cost may be exist over a longer time frame, which may be why it persisted in the longitudinal analysis.

As described previously, yet another reason why the relationship of continuity and hospital cost may persist in the longitudinal analysis, whereas the relationship between continuity and number of total hospitalizations did not, may be that most hospital costs are accounted for by the serious chronic illnesses involved in the ACSC hospitalization outcome or at least that the proportion of hospital costs accounted for by these chronic illnesses is the portion most sensitive to continuity of FP care. If higher continuity is more likely to be reflected in a reduction in hospitalizations for more serious conditions or in a reduction in hospitalizations in which the patient is sicker, then one should expect continuity to be associated with a reduction in hospital length of stay. In fact, Wasson et al. (1984) found that continuity of primary care provider was associated with a reduction in length of stay while Gill (1997) actually found a similar association in the absence of any corresponding reduction in number of hospitalizations. Alternatively, it may be that relationship between continuity and hospital cost may be stronger and less likely to be masked by the difference in measurement time frames than total hospital utilization.

The observation here of a strengthening of the association of continuity and health care utilization and costs with increasing age provides support for suggestions in the literature that continuity may be particularly important the elderly, a particularly vulnerable group. Given the observed increase in chronic health conditions with age, the mechanism by which continuity may exert its increased protective effects in reducing heather care utilization may be through continuity of care resulting in better prevention and management of chronic illness (Menec et al., 2006). The finding in the current study of a stronger association between high continuity and a reduction in hospitalizations for

ACSCs, than between continuity and total hospitalizations provides evidence for this. Indeed research has shown continuity of care to have increased importance for the chronically ill (Nutting et al., 2003; Hollander et al. 2009).

In the current study we actually have no way to judge appropriateness of care and any reductions in health care services utilization and cost are generally assumed to be beneficial and from the perspective of a policy/decision-maker, prevention of specialist contacts and hospitalizations may be preferred due to their high cost. However, in some situations it may actually be in the patient's best interest to see a specialist or undergo hospitalization in order to treat/manage a health condition, thus improving the patient health status/outcomes. This actually may save costs to the health care system by preventing or reducing future hospitalization. Gill (1997) states that hospitalization at times may be a "necessary and appropriate" aspect of health care; for example, a person may require a procedure such as coronary revascularization as a treatment for coronary artery disease. A person who has a regular source of care may, in some cases, actually be more likely to be hospitalized in order to receive the procedure, whereas a person without a regular source of care may not have the opportunity because they have no regular doctor to recommend the procedure (Gill et al, 1997), and they may even be less likely to have their coronary artery disease diagnosed in the first place. Thus, continuity of care may actually increase the likelihood of hospitalization in certain situations. This hypothesis is supported by research by Weinberger et al. (1996) who found that a regular source of primary care after hospitalization increased hospital readmission rate.

Therefore, higher continuity may increase the likelihood of a utilization of a resource in some situations and decrease its likelihood in others. Thus, the total use of a resource may not always be the best indicator of good primary care (e.g. continuity of care) (Hjortdahl and Borchgrevnick, 1991). This point is illustrated in a study by Hjortdahl and Borchgrevnick (1991) using the decision whether to prescribe as an outcome. They found that when a doctor reported having accumulated previous knowledge of a patient, this played a role in the decision to prescribe in more than 30% of cases, resulting in more liberal prescribing in 42% of these cases and more restrictive prescribing and 58% of these cases, depending on the situation. Thus, knowledge of patient history could work both ways depending on the circumstances, and resulted in an overall net decrease in prescribing of only 5%.

Similar logic may apply to outcomes used in the current study. For example, that is, in some cases continuity of care may be responsible for prevention of specialist referral and/or hospitalization while in others it may contribute to it, depending on the circumstances. This may partially explain why we did not observe higher continuity of care to be associated with a reduction in all outcomes, or with the same outcomes in different analyses.

Another consideration is that high continuity with an FP may not always be an indicator of optimal care (Gill and Mainous, 1998). For people with certain health conditions it may be more appropriate for them to be receiving care from both an FP and a specialist. Although this would lower their FP continuity score, it may improve outcomes and reduce hospitalizations for sicker patients (Mainous and Gill, 1998)

A further point is that the decision to whether or not to hospitalize or refer the patient to a specialist is often a complicated decision, which can depend on many factors, including the disease involved, the seriousness of the case, co-morbid conditions as well as a host of patient and doctor characteristics and other circumstances. Although administrative databases are very good sources of information about health care services utilization patterns and presence or absence of specific diagnoses, they are not able to provide us with information on the seriousness of a patient's disease condition, specific patient or physician characteristics, or other aspects of the circumstances which contribute to a hospitalization or specialist referral. This is why the regression models in the current study only account for a small amount of the variation in health care services utilization outcomes. It is these characteristics on which future research should focus.

Overall our study has found several pieces of evidence, which support the claim that it is actually continuity of care, which is driving the observed reductions in outcomes. Here we look at the results with reference to the following criteria for establishing a causal relationship. (Mausner and Kramer, 1985):

1) Strength of association
2) "Dose-response" relationship
3) Consistency of findings
4) Appropriate temporal relationship
5) Accounting for confounders/alternative explanations
6) Clinical plausibility of findings

1) First is the strength of the association. Associations between continuity and health care services utilization and cost measures were found to be of moderate magnitude, in particular for older people.

2) Second, a "dose-response" relationship was found for higher age groups in which hospitalizations and specialist contacts, and to a lesser extent, costs were found to increase with decreasing continuity (or decrease with increasing continuity).

3) Third, the findings for association between continuity and health care utilization has been demonstrated in two different study samples in the current study and associations of continuity with utilization and costs found in our study have been demonstrated in previous studies in other settings such as other Canadian Provinces and other countries. Similar findings have been demonstrated in different populations including children, adults and the elderly, different income groups as well as people of different races such as whites, African-Americans and Hispanic-Americans.

4) The fourth criteria, appropriate temporal relationship, applies to the hospitalizations for ACSCs and hospital cost outcomes, given that these were the outcomes for which an association with continuity persisted in the longitudinal analysis in Phase II. In this analysis we can be reasonably certain that the appropriate temporal relationship between the exposure variable (continuity of care) and these two outcomes existed given that

continuity of care was measured over a two-year period and outcomes measured in the two-year period immediately following. Associations of continuity of care with specialist/total physician and total hospital utilization and specialist/total physician costs were only demonstrated in the Phase I analysis and cross-sectional analysis of Phase II, and thus the temporal relationship between continuity and outcomes was difficult to discern due to the cross-sectional design of these analyses. As was previously stated, the reason why specialist and total hospital utilization and specialist costs did not show an association with continuity in the longitudinal analysis may be that in order to detect an association it may be important to capture family physician visits patterns (i.e. continuity) and outcome events in close proximity to each other, and measurement of continuity and outcomes over separate periods introduces an artificial disconnect which may prevent detection of any association or it may be that continuity levels during the period which continuity was measured were different than during the period in which outcomes were measured. Alternatively, for these other outcomes it may be that it is not continuity which is driving the associations seen in the cross-sectional analysis but it may be, for example, that healthy people with low specialist usage may be satisfied with their FP and tend to remain with him or her.

5) Fifth, controlling for other factors affecting health care services utilization in multivariate analyses such as predisposing, need and enabling factors allowed us to show that the demonstrated associations of higher continuity with reductions in health care utilization and cost measures were independent of effects of these confounding variables.

6) Sixth and finally, there is clinical plausibility to the findings that good continuity of care with a primary care physician may lead to reductions in health care utilization and costs. The mechanisms by which this may occur are suggested in the next section.

5.8 Mechanisms of Action of Continuity of Family Physician Care

Many authors feel that the most important component of continuity in primary care is relational continuity (Reid et al., 2002) where a patient has a "sustained relationship" with a primary care physician "which transcends illnesses over time" (Freeman et al., 1985). Patient and family physician may develop a personal relationship, which may lead to an enduring sense of trust and mutual understanding between patient and doctor as well as to the doctor forming a sense of responsibility for the patient's care over time (Reid et al, 2002). Trust may occur because the patient sees the physician as "competent, responsible and caring" (Mechanic, 1996). A trusting patient –provider relationship is an important component of better health outcome (Gill et al., 1997). Trust may facilitate better communication between patient and doctor and may make patients more comfortable and thus more likely to divulge information which may be important for care as well as more likely to adhere to medication and treatment regimens (Starfield, 1998; Reid et al., 2002). Continuity may also make it easier for the provider to make use of skills which the patient may possess, such as the ability to clarify his or her needs as well as aid the provider in assessing his or her condition or in detecting a problem (Emanuel and Dubler, 1995). Continuity has been said to form a "bridge between past and current care events" and may allow the doctor to accumulate medical and contextual knowledge important for care of the patient (Reid et al., 2002). It may be this knowledge of the patient, which allows for better problem recognition, diagnostic accuracy, and more appropriate use of medical/health care resources (Reid et al, 2002; Hjortdahl and Borchgrevik, 1991). Continuity of care has been found to be associated with lower likelihood of duplicating previously-performed work, reductions in unnecessary diagnostic tests and prescriptions (Heagarty et al., 1970; Breslau and Reeb, 1975; Breslau and Haug, 1976; Starfield et al., 1976) and, in the present study, we have demonstrated an association of higher continuity with reduced specialist contacts, hospitalizations and associated costs, as has been found in other studies.

As stated by Gill and Mainous (1998), whether or not to hospitalize a patient is a very complex decision, which requires the physician to be able to assess the patient's current condition as well as have knowledge about previous medical history and other characteristics of the patient. A regular provider of care would be more familiar with the patient, more acquainted with the patient's health problems, especially for chronic diseases (Lin et al., 2010), and thus be better equipped to assess a developing or on-going illness (Wright, 1983), probe for possible complications (Lin et al., 2010) and decide whether the patient would be better off being hospitalized or managed at home. Also, continuity of care may result higher patient satisfaction and trust in the physician, which may result in a "greater willingness to manage serious medical problem at home" (Gill and Mainous, 1998). In addition, continuity of care has been shown to be associated with increased preventive interventions (Menec et al., 2005; Gulliford et al., 2007; Fenton et al., 2008), which may also be responsible for primary and secondary illness prevention, which could result in reductions in hospitalization and other types of health care services utilization. There are a number of highly effective clinical interventions that, when properly delivered, can reduce disease and improve the quality of life of people at risk of, or living with, chronic diseases. These include promotion of behaviour change, recommendation of regular screening or regular diagnostic tests or examinations, such as glucose/ HbA_{1c} testing, and regular eye examination and foot care for diabetics, as well as use of pharmacological agents such as blood-pressure medication or cholesterol or glucose-lowering medication which reduce risk of serious illness. The finding that continuity of FP care was associated with reductions in hospitalizations for ACSCs and that the magnitude of reduction was greater for hospitalizations for ACSCs than it was for total hospitalizations is evidence that continuity of FP care may indeed be exerting its benefits by allowing for better prevention/management of chronic illness. Also, the reduction in hospitalizations for ACSCs in particular became greater with age, suggesting an "increased importance" of continuity of care and prevention/management of chronic illness in older people. It should also be noted, however, that the decision of whether or not to hospitalize a patient may not necessarily be made by the FP. If, for example, a patient self-refers to the ER this decision would be made by the specialist with control over hospital beds.

The decision of whether or not to refer to a specialist may also be a complicated decision, which also depends on many factors including characteristics of the patient, characteristics of the primary care practice, access to specialist care, as well as characteristics of the FP such as years in practice, skill in dealing with the particular health condition of the patient and knowledge of and previous experience with specialists (Pitterman and Koritsas, 2005; Hollander et al, 2009). As was previously mentioned, Starfield et al. (2009) state, if there is low continuity of primary care provider, it is likely to be associated with "increased unfamiliarity with patients, and greater uncertainty which may lead to a "greater tendency to refer" [patients] to specialist care.

5.9 Modified Conceptual Model Supported by the Results

Figure 5.1 presents conceptual models based upon Andersen's model illustrating the findings of the study. Figure 5.1A illustrates the factors which were found to influence hospitalizations for ACSCs and hospital costs which, according to Andersen's model, fall into three main categories: 1) Predisposing factors affecting health these outcomes were gender and age; 2) Enabling factors affecting outcomes included income and rural/urban place of residence. Continuity of care (i.e. regular source of care) was also considered and enabling factor for purposes of the study; 3) Need factors included number of chronic illnesses. These outcomes were only tested using the MCP sample, which limited co-variates.

Figure 5.1 Final Models of Determinants of Health Care Services Utilization and Costs

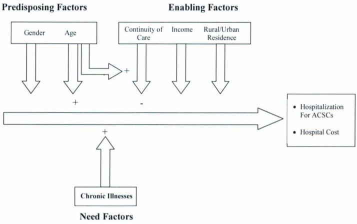

Figure 5.1A Model of Determinants of Hospitalizations for ACSCs

The main findings of the study are illustrated in the central portion of the model. Older age and a higher number of chronic illnesses were shown to be associated with increased hospitalization for ACSCs and hospital costs. A higher level continuity of FP care was found to be associated with a reduction in hospitalizations for ACSCs and hospital cost. Reductions in hospitalizations ACSCs and hospital costs tended to be greater at older age groups in both cross-sectional analysis, where continuity and outcomes were measured over the same time period; and in longitudinal analysis, where continuity was measured over a time-period prior to that when outcomes were measured. This provides strong evidence that it is continuity of care, which is driving the observed reduction in outcomes and that age is affecting the relationship between continuity of care and the hospitalization for ACSCs and hospital cost outcomes. Thus, in the model we propose that age is also acting as a moderating variable on the relationship between continuity and these two outcomes, where higher age acts to increase the effects of higher continuity of care in reducing hospitalization for ACSCs and hospital costs, resulting in greater reductions at older ages. The increased reduction in hospitalizations for ACSCs consisting of several serious chronic illnesses used for this measure in the current study, suggest that the mechanism though which continuity of care may exert its benefits is through improved prevention/management of chronic illness which may have "increased importance" in older people (Menec et al., 2006).

Figure 5.1B illustrates a similar model for total hospitalizations which involved similar predictors of health care services use with the addition of physical activity level and marital status co-variates, which were shown to be significant predictors of total hospitalization in the CCHS analysis. Although, higher continuity was associated with reductions in total hospitalizations in the cross-sectional analyses and this effect was stronger at older age groups, in the longitudinal analyses there was no clear relationship between continuity and hospitalization. Thus, evidence that it is actually continuity which is driving the reduction in hospitalization is not as strong as seen above with hospitalization for ACSCs and hospital costs, and the effect of continuity on total hospitalization is not as clear and is indicated by a '?' in the model.

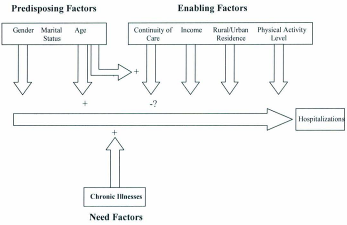

Figure 5.1B Model of Determinants of Total Hospitalizations

Figure 5.1C illustrates a similar model for the remaining health care services utilization and cost outcomes tested in the current study. The relationship of continuity with these outcomes was also inconsistent in different analyses performed in the study and thus the relationship between continuity and these outcomes is not a clear from the study results. This is again indicated by a '?' in the model.

One other point of note is that the study also provided evidence that age acts as a moderating variable on the relationship between other pairs of variables. For example, in the CCHS analysis there was no significant relationship between marital status and hospitalization for the whole sample, but in the older age groups unpartnered marital

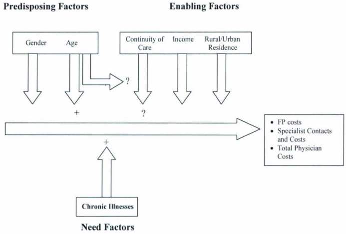

Figure 5.1C Model of Determinants of Hospitalizations for Remaining Outcomes

status was associated with a greater number of hospitalizations relative to partnered.

5.10 Research Contributions of the Current Study

The study is the first to examine the association of continuity of care with health care services utilization in the province of Newfoundland and Labrador and one of only a few studies to do so in Canada where people receive universal health care coverage and, for the most part, have free choice of primary care physician, although this may be limited by access, particularly in rural areas. Most research on continuity of care has been done in the United States and Europe. The present study is one of the few examining the association of continuity of primary care physician with hospital utilization and cost and one of even fewer to examine the relation between continuity of FP care and specialist utilization and cost. It adds to the relatively modest literature on the economic benefits of continuity of primary care. To our knowledge, it is the first study to examine the relationship of continuity of FP care with specialist utilization outcomes in a general primary care sample including hospitalized people. Our study also examines the relationship of continuity of care and outcomes over a longer time period (four years) than most other studies on the topic, which have used study periods of 1-2 years (Lin et al., 2010). This is especially important give the slow, progressive nature of many chronic illnesses such as diabetes (Lin et al., 2010).

In addition, the study is one of the first to examine the effect of age on the relationship of continuity with health care services and costs by conducting analyses in different age groups in the same study (including the elderly), and again the first to do so in a general primary care sample including hospitalized individuals. The majority of previous studies on the topic have involved either adult or pediatric populations, while only a few studies have focused on elderly populations (Worrall and Knight, 2006), although the number of studies in elderly populations has been increasing (Menec et al., 2006; Ionescu-Ittu, 2007).

Another important contribution of the study is that it uses more appropriate multivariate regression techniques than employed by most other studies examining the relationship between continuity of primary care physician and health services outcomes and costs. Most studies examining the association of continuity with health services use binary logistic regression either to examine the association of continuity with the probability of receiving a health care service (e.g. probability of hospitalization), or to examine the association of continuity with only two categories of utilization (e.g. having 0-2 hospitalizations vs. 3+). By categorizing outcome measures we lose information. From a policy perspective, it is more useful to know the numbers of hospitalizations which higher continuity of care may prevent rather than just knowing the number of people that could be kept out of hospital. In the present study we use Poisson regression, which is more appropriate for modeling discrete data or counts, the category of data into which health care services utilization data falls. It allows us to truly measure the association of continuity with health care utilization in terms of numbers of events.

Also, when data were overdispersed we made use of negative binomial regression which incorporates an overdispersion parameter that accounts for the excessive variability in health care services data. If not accounted for, overdispersion may result in an underestimation of standard errors, narrower confidence intervals, and smaller P values (Agresti, 2002).

Also, most studies of health care services cost use ordinary least squares (OLS) regression when predicting cost. Given that health care cost data often has a lot of 'zero cases' associated with it where the individual had no usage of a particular health service (e.g. zero hospitalizations and thus zero cost), if there are a lot of zero cases it becomes difficult for data to be normally-distributed even with log- or other transformation. This is a violation of an assumption of OLS regression. How zero cost cases are dealt with is rarely mentioned in the literature. The current study makes use of tobit analysis when modeling health care cost data, which allows for censoring of zero cases and is thus a more appropriate technique to use for modeling health care costs than OLS regression.

Finally, through the study we propose a modified model of health services use, based on Andersen's model, incorporating a visit-based measure of continuity of primary care. Many other studies using Andersen's model as a framework have used less sophisticated measures of primary care utilization.

5.11 Strengths of the Current Study

There are many strengths associated with the current study. First of all, it was a data linkage study involving the merger of survey and registry samples with administrative physician claims and hospital discharge data. Data linkage allows for a much more powerful analysis of the combined data than if data sources were used in isolation (Lazaridis, 1997). Second, the study made use of population-based data sources. The study utilized two randomly-selected population-based samples taken from a national health survey and the provincial health insurance registry file which were thought to be representative of the NL population at the provincial level. Evidence of a relationship of continuity of care with health care services utilization and cost was found in both samples. The study carries with it the strengths of the two population-based administrative health care services data sources which, in addition to being readily available and inexpensive to use, provided complete, objective health care services data on acute hospital separations and fee-for-service physician billing events and allowed continuity of care measures to be calculated from the objective healthcare utilization data, which is in contrast to many earlier studies of continuity of care which relied on self-reported measures of access and continuity of primary care which would be subject to biases (Weiss and Blustein 1996; Ionescu-Ittu et al, 2007).

Hospitalization data in the Province has been validated (Newfoundland and Labrador Centre for Health Information, 2004) and physician claims data is generally assumed to be complete (Segovia and Edwards, 2001). Utilization of administrative health care services data was most likely much more accurate and comprehensive than relying on self-reported health care utilization data or asking a person to identify their regular source of care or estimate their level of continuity of care in a survey. These other approaches are subjective and may be associated with recall and selection biases (Joffe et al., 1999). In fact, it was found that reporting no regular source of health care in a national survey was actually an unreliable indicator of poor continuity or care (Ettner et al., 1996). Also, the survey and administrative data sources allowed for record-level analysis of utilization at the level of the individual. The physician claims file also contained data on direct cost of services provided and the hospital data allowed for use of nationally-recognized costing methodology used by the Canadian Institute for Health Information (CIHI). The methodology is based on cost per weighted case data published nationally by CIHI as well as on a resource intensity weighting for each hospitalization event which allows for cost-adjustment for expected length of stay based on patient diagnosis/ procedure, co-morbidities and age.

In addition, the survey provided a rich set of variables which could be used as co-variates in the analysis, while the MCP registry sample allowed for a complementary analysis with a much larger sample size which, while having fewer variables to add to the analysis, allowed for more statistical power. In both analyses variables known to impact health care services were controlled for, and the independent effect of continuity of FP care on health care services utilization and cost could be ascertained. Finally, the study showed relationships of continuity of care with outcomes using two different study designs, cross-sectional and longitudinal.

5.12 Study Limitations

The main limitation of the study is that the provincial physician claims file (MCP) used in the study to obtain FP and specialist utilization data and calculate continuity indices tracked only fee-for-service physician visits. In NL, approximately two thirds of physicians are paid on a fee-for-service basis. The remaining third are salaried and scattered mostly outside urban centres (Department of Health and Community Services, Government of Newfoundland and Labrador, 2000). Thus, the data most likely underestimated health care service utilization and may have not reflected a totally accurate picture of continuity of care patterns, especially in rural areas. However, it is thought that a lot of people who mainly utilize salaried physicians would have been eliminated from the sample due to exclusion of residents of the Labrador and Grenfell Health Boards, as well as due to the three FP-visit cut-off exclusion criterion used in the study.

Given that the physician claims file used in the current study only allows for a coding of a single diagnosis, this may result in underestimation of certain health conditions, in particular co-morbid conditions. This may have resulted in underestimation of health conditions for the 'number of chronic conditions' variable in the current study as well as of the number of hospitalizations for ASCSs. Administrative data have also been associated with problems such as missing data and a lack of standardized reporting conventions (Joffe et al, 1999). In addition, in physician claims data diagnostic fields are often unreliable relative to fee/service code fields which describe services provided, given that physician payments often depends on the latter and not the diagnosis per se. Finally, in the absence of an unbiased reference standard, good validation of physician claims data is not always possible.

Use of survey data is also associated with limitations. Self-reported data should be interpreted with caution because it is often associated with information bias including recall bias and social desirability bias. Recall bias refers to the fact that survey respondents often find it difficult to accurately recall past events especially if the reflected period is long and also possible selective recall of events by members of one group relative to a comparator group. An example of this would be when respondents were asked to recall whether they had been diagnosed with a specific chronic illness. Social desirability bias refers to respondents providing interviewers with a response which they perceived to be more-socially-desirable or which they felt the interviewer might want to hear, and that this may be more likely in one group than in another. This is perhaps most relevant for questions about lifestyle, socio-economic status or health status where society might see a particular response as good or bad. For example, a respondent might tend to report that they are more physically active than they are in reality or that they have a higher income or education level than they actually have. Survey data is also subject to selection or non-response bias. For example people in rural areas with poor health care access and continuity of care may be underrepresented in the survey, which may inflate measures of continuity of care. Finally, large population-based surveys may be subject to cluster bias where groups or people in the same geographic area may behave in a similar fashion.

Another limitation of the CCHS is its relatively small sample size due to exclusions of survey respondents from the study due to non-linkage, exclusion of the Labrador and Grenfell Health regions, as well as exclusion of respondents with less than three FP visits, which reduced the CCHS sample size. Furthermore, the sample had to be subdivided into categories of continuity of care level, etc. leaving relatively small numbers in each of these categories, especially in the older age groups. Although the numbers are large enough to perform statistical tests, the survey portion of the study (i.e. Phase I) thus has relatively low power. A larger survey sample would have increased power and thus increased ability to detect statistically significant differences. Sample size may have also limited statistical power thus limiting findings of significant differences when using the second set of age groups used in MCP (Phase II analysis). For example, lack of associations of continuity with hospital costs in the 65-74 and 75+ age groups may have been due to their sample size being much smaller than the 45-64 age group were a significant continuity-cost association was found. This is especially true for rare outcomes such as hospitalization and hospitalizations for ACSCs. In the cost analysis using tobit analysis, the combination of a small sample size and the rarity of hospitalization events resulted in wide confidence intervals, thus it was decided that, for multivariate analyses of hospital cost, tobit analysis would be abandoned, cases with zero hospital cost would be removed, and OLS regression would be used for analysis (along with log-transformation to attain normality).

Also, given that sample selection was based on health region and the original sample weights (relating the number of people in the sample to the number of represented people in the population) were calculated for the whole survey sample, because of exclusion of such a significant proportion of survey respondents, the sample may no longer have been as representative of the provincial population.

The cross-sectional design of the two four-year analyses (Phase I using the CCHS and the cross-sectional analysis of Phase II MCP sample) where co-variates, predictors and outcomes variables were collected over the same four-year period, limited our ability to draw causal inferences about relationships. The longitudinal analysis of phase II improved upon this by measuring the main predictor variable (continuity of care) and the 'number of FP visits' co-variate over a two-year period and measuring outcomes in the two-year period immediately following. Despite this, the fact that continuity groups were naturally-existing and not randomly assigned in both the two 4-year and longitudinal analyses may have resulted in selection bias meaning that there may be differences in other variables unaccounted for in the analysis (unobserved heterogeneity), which may be playing a role in the observed effects.

Another problem is that in a study such at this, using multiple outcome measures and multiple analyses is associated with increased risk of finding an observed difference to be statistically-significant due to chance alone for any one or more outcome measure.

As mentioned previously, another limitation of the study was that, although the administrative databases allowed us to track health care utilization including continuity of FP patterns, as well as determine presence or absence of specific diagnoses, there were otherwise limited in the information they could provide. We were not able determine details or reasons for the patterns of care observed. For example, if a patient had low continuity of care we did not know whether it was the result of access to care problems or personal choice. We were able determine that a patient had specific diagnoses but could not separate serious or life-threatening cases from those that were less serious in nature. We were not able to determine the exact reason for family physician visits (e.g. prevention vs. treatment/management) or the overall level of quality of care which patients received. We were not able to determine whether a given doctor was aware that a patient was receiving care from another doctor, or whether there was communication among providers about patient care. Although we were able to determine whether a given physician visit was the result of referral by another physician, we could not track visits to the referring physician nor could we determine if physician visits had been prescheduled in advance and/or at regular intervals. In addition, the data sources only allowed us to track physician and hospital care and associated costs. Costs of other services such as laboratory or diagnostic tests were excluded and there were no data included on non-physician community health services (e.g nurses, psychologists or social workers). Nor were there data on indirect health care costs, out-of-pocket costs to the patient or intangible costs to the patient such as changes in quality of life or premature deaths.

Also, we only measured continuity of care for FP home and office visits. We did not include FP contacts happening elsewhere and continuity of care with specialists or non-physician health care provider (e.g. diabetes nurses) was not measured, and we did not account for continuity of specialist care.

Another aspect of FP health care patterns that would have been useful to measure, but that we were unable to look at, was whether a patient had good continuity of care in relation to primary health care practice rather than with individual FP as measured in this study. It might be expected that continuity of care would be better at the practice level than at the level of the individual FP, as a patient might be referred to another physician within the practice if his or her primary physician were unavailable (Menec et al., 2006). The other physician would have access to the patient's history on the patient chart and it would be interesting to see if continuity with individual physician was associated with benefits over and above those associated with good practice continuity. However, the lack of a practice identifier per se in the physician claims file, allowing for determination of whether patients were seeing physicians in the same group practice, prevented us from examining continuity of practice. There was a postal code for each physician in another file called the provider file, but it was relatively unreliable and one could not be certain if the postal code was actually for the place of practice or for billing and/or payment purposes. There would also have been the associated problem of tracking visits for physicians who had multiple sites of practice.

Another limitation of the study is that we were unable to remove patients from the sample who may have moved out of the province during the course of the study given that we were only able to determine their place of residence at one point in time through either the CCHS survey or the 2003 MCP registry file which we used to select the study samples. This group is often excluded in other studies. In addition we did not remove people who died during the study period. Both of these factors may have affected the relationships found for continuity of care with health care services utilization and costs. However, given that older and sicker people would have been most likely to die over the course of the study period, if we had removed people who died during the study period, the relationship between continuity and outcomes would most likely have been reduced in the elderly, which may not have been indicative of the true relationship.

There are also some problems/limitations which may be associated with the COC index itself. For example, the index lacks intuitive interpretation, may mask differences in sequencing of care, and may produce inaccurately high values for very low and very high users of care (Steinwachs, 1979; Reid et al., 2002).

Also, given that data were limited to Newfoundland and Labrador and that physician data used for the study was exclusively fee-for-service, the extent to which the results are generalizable to other areas and physicians using other methods of remuneration is unknown. Removing the zero-cost cases from the hospital cost analyses may have also reduced the generalizability of study findings

Finally, although the study has demonstrated an association between continuity of FP care and reduced health care services utilization and costs, and provided evidence that it is actually continuity that is driving the observed reduction, the study did not allow for determination exactly why the association exists. An index-based measure can only serve as a proxy that one or more types of continuity of care exist, such as interpersonal continuity between patient and provider. There are many types of continuity and/or different suggested mechanisms by which continuity of care may provide benefits observed (Menec et al., 2006). For example, relational or interpersonal continuity is where the patient has built a trusting personal relationship with a primary health care provider. The patient has come to trust the provider and may be more likely to disclose health information to the provider, which is important for treatment and may also be more likely to adhere to medication or other treatment regimens (Becker et al., 1972; Becker et al, 1974a). Another type of continuity is informational continuity is where the provider has access to the relevant health information he or she needs in order to appropriately treat the patient, whether it is passed from other providers or maintained in a patient chart or electronic medical record. Indeed, sometimes there may be an overlap in different types of continuity where divisions between them are blurred. For example, by having a good personal relationship with a patient, a primary care physician may gain contextual information about the patient, which is useful for patient treatment and management. These details of which aspect of continuity of care is responsible for observed benefits in the current study can only be elucidated through further research.

5.13 Suggestions for Improvements to the Current Study and Future Policy-relevant Research

Perhaps the most important suggestion for improvement in the study would be for researchers and policy-makers to advocate for shadow-billing for salaried physicians in the province which would allow visits to salaried physician visits to be incorporated into the MCP physician claims file on a regular basis. This would allow a researcher to paint a more accurate picture of physician utilization and continuity of FP care at a truly provincial level.

Recalculation of CCHS sample weights by Statistics Canada after linkage and all other relevant exclusions from the sample, although expensive, would aid in ensuring that the survey sample remains as representative of the Provincial population as possible. Cluster analysis and/or multi-level analysis would allow for adjustment to deal with possible cluster bias in the survey sample. In addition, more recent CCHS cycles could be combined with the CCHS 1.1 sample to increase sample size and statistical power and obtain a more accurate picture of the relationship between continuity of care and health-related outcomes in the province. Also, selection of a large age-stratified sample for the MCP registry, ensuring a large sample for each age group, in particular the older age groups, would allow for more statistical power at each age group thus permitting the researcher to more accurately determine the effect of age on the relationship of continuity with health care services utilization and costs.

Examining the relationship of continuity of care with other co-variates and outcomes available in the current data sources, such as reason for hospitalization and length of stay, co-morbid conditions, complexity of illness and measures of required hospital resources (e.g. resource intensity weightings in the hospital data) might shed more light on the circumstances under which continuity of care is most beneficial and why. For example, why higher continuity was associated with a reduction in hospital cost but not with hospital utilization in the longitudinal analysis of the current study. Future research in Newfoundland and Labrador could also investigate the effects of continuity of care on other outcomes using other data sources such as mortality, cause of death, early vs. late diagnosis, laboratory data such as HbA1c levels in diabetes, or pharmaceutical data, the latter of which will soon be possible given the recent start-up of the Newfoundland and Labrador Pharmacy Network.

Also, determination of which of the study patients were nursing home residents would allow them to be removed from the study sample to examine the effects of their removal on the study results. Similar sensitivity analyses could also be conducted by excluding patients with a high number of specialist visits or hospitalizations in order to examine whether their removal would result in a strengthening of the association between continuity of FP care and health care services utilization outcomes and costs. We actually conducted a sensitivity analysis where we excluded patients with chronic renal failure because they may have been under the care of a nephrologist and tended to have an excess of specialist visits. However, this resulted in little change to the study results.

Future research should also focus on determination of the chronic illnesses for which continuity of FP care may be most important in terms of reductions in hospitalizations, specialists visits and associated costs, rather than just incorporating a variable for 'number of chronic conditions' as was done in the current study. Separate analyses could be performed on people falling within different chronic illness groupings (e.g. heart disease, chronic respiratory disease or cancer) to examine which disease grouping demonstrated the strongest association between continuity and health care services utilization.

Future research should also focus on the examination of different time frames for measuring continuity and outcomes. For example, incorporation of a longer follow-up period in the longitudinal analyses may provide opportunity to gain greater understanding of the effect of continuity on outcomes by observing them over a longer period. Expanding the time period over which continuity is measured may also aid in shedding light on the relationship between continuity and outcomes. This research could also utilize other available co-variates not used in the current study such as self-perceived health status, disability measures, and measures of severity of chronic illness such as diabetes.

As mentioned above, all available CCHS cycles could be combined to increase sample size. Linkage of this combined dataset to administrative health care services utilization data sources such as vital statistics data, the Pharmacy Network and laboratory data would allow for panel data on health care services utilization in the province similar although larger and more comprehensive than the previous Newfoundland Panel of Health and Medical Care. Panel data on health care services utilization patterns could be combined with special regression techniques such as fixed and random effects analyses to reduce unobserved heterogeneity and, thus, better understand the relationship between continuity of care and outcomes.

5.14 Some Further Policy Implications

The results of the current study are similar to the majority of the literature demonstrating the importance of continuity of FP care and the patient-family doctor relationship in improving patient outcomes and reducing health care services and associated costs. These findings suggest that in order to reduce hospital and specialist utilization and cost to the health care system -- in particular hospitalizations for ACSCs and hospital costs, health policy stakeholders should develop and promote initiatives to maintain or enhance continuity of FP care and the patient-family doctor relationship. Mechanisms to maintain or enhance continuity of primary care provider, should continue to be incorporated into any primary health care reform initiatives, and this is especially true for vulnerable populations, for which continuity of care may have increased importance, such as the elderly and chronically ill. Menec et al. (2006) points out that this has been recognized by policy makers and current Canadian primary health care reform proposals incorporate suggestions which would improve continuity of care such as patient registration with a primary health care practice and encouraging a team approach to primary health care. Menec states that the latter would also improve primary care access and allow access to the appropriate care provider at the appropriate place and time either by personal service or telephone triage (Menec et al., 2006). I would argue that although primary health care teams may improve access to care and comprehensiveness of care, they may be detrimental to relational continuity of primary care provider and informational continuity (Reid et al., 2003). With primary health care reforms encouraging development of primary health care teams, the results of the current study may suggest that it is important that continuity of care between the patient and the primary care physician should not be completely eliminated through the use of a team of multiple providers (Love et al., 2000).

The findings of the study demonstrated the importance of continuity of primary care provider in maintaining good patient outcomes and reducing cost to the health care system, especially in the elderly. Mitton et al. (2005) who found an association of continuity of primary care provider with a reduction in hospital utilization and costs in patients with severe mental illness, and that higher-need patients cost the system more argue that interventions to improve continuity would be a way to improve patient outcomes, while at the same time, be a mechanism for shifting cost away from hospitals to the community, preferably without an increase in total health care cost. They also state that that future experimental research is needed to conclusively determine whether improving continuity of care for those with greater need are actually able to divert cost into the community.

In commenting on the policy implications of the findings of their study that continuity of care reduces specialist contacts, which was similar to our results, Starfield et al. (2009) argue that excessive specialist supply combined with inappropriate use of specialists can lead to greater frequency of diagnostic tests, more false-positive results and worse outcomes than appropriate specialist use, and that seeking care from multiple physicians, especially in the presence of high level of morbidity is likely to be associated with greater likelihood of adverse side effects.

Another policy issue involves the ambiguity found in the literature where continuity has been found to improve outcomes in some instances but not in others. Most studies do not distinguish between the types of patients and circumstances in which continuity may be particularly important. Christakis (2003) argues that perhaps we should not be asking, "Does continuity of care make a difference at the population level?", but whether there "are there specific subpopulations, or vulnerable populations, for which continuity of care is especially valuable". "Vulnerable populations are often thought of as groups whose demographic, geographic or economic characteristics may prevent or impede their access to health care services, in particular, primary care" (Blumenthal et al., 1995). Indeed, Nutting et al., (2003) found that continuity of care is valued more by certain vulnerable populations such as people at both extremes of age, the chronically ill and those of low social-economic status, for whom continuity of care may be more important and studies have found the relationship of continuity of primary care with reduction in health care services use to be greater in these populations (Chistakis et al., 2001b; Starfield, 2009, Hollander et al, 2009). The findings of the present study provide support for increased value of continuity of care in elderly populations in terms of improved health outcomes, where evidence was found for increased efficacy of continuity of care in reducing health care services utilization and costs for this vulnerable group.

Sweeney and Gray (1995) provide another specific example of a vulnerable population with reduced continuity of care in a population of primary care patients in southwest England. Patients with lower continuity tended to be underprivileged people with a general lack of access to a regular care provider and were also more likely to be depressed and have problems with personal relationships as well as a dysfunctional relationship with their primary care provider. This group may have problems developing and maintaining a relationship with a primary health care provider and, like other vulnerable groups, may benefit from special interventions such as improvement to continuity of care, a topic which requires further research (Sweeney and Gray, 1995).

The fact that some groups have been shown to have quite low levels of continuity suggests that there may be a need for more health education to patients about the importance of continuity of care and establishing a solid patient-provider relationship as well as the need for interventions to improve continuity of care for these populations. Available administrative data and continuity of care indices could be used to both identify groups in the Province with low continuity and also used as a tool to monitor and evaluate the progress of any interventions intended to improve continuity of care (Lin et al, 2010).

Although, the current study and most studies of continuity of care envision continuity of care as a predictor or independent variable influencing health care processes, costs and patient outcomes, more recently Christakis (2003) has suggested that given the overwhelming evidence that of continuity of care improves outcomes "it may be time to declare continuity of care as a [desirable] outcome in its own right and spur subsequent research on how to better achieve it". Conversely, Christakis (2003) also brings up the point that, given that continuity of care may not be particularly important for all groups of people, and there is a question of whether continuity should be "forced" upon everyone, including those who don't need or want it, or those who are unaware of the possible benefits.

Also, although we've been referring to the measures of health care services utilization and costs as outcomes, they are actually measures of processes of care and more examination of true health outcomes are needed in order to investigate the true long-term benefit of continuity of care. In addition experimental research examining the relationship of continuity of care with health care utilization and cost outcomes is needed in order to minimize the possibility of confounding by unknown variables, although it is unlikely that this type of study will ever be done in Canada as patients are unlikely to agree to be randomly assigned to regular care or to a low-continuity situation (Worrall and Knight, 2006). A better solution may be to take advantage of "naturally-occurring experiments" or opportunities for pre-post studies that may occur as primary health care changes over time, which may allow for investigation of the effects of continuity of care on health outcomes (Worrall and Knight, 2006). Perhaps most importantly, future research should focus on factors and mechanisms that might explain the observed association between continuity and reduced health care services utilization, which could use both quantitative and qualitative methods, such as an investigation of whether it is the relational or informational aspect of continuity of FP care, which is to be more closely associated with outcomes.

5.15 Conclusion

The main conclusion of the study is that higher continuity of FP care is associated reductions in hospital and physician specialist utilization and costs. The association is stronger in older people and persists after accounting for other factors known to affect health care utilization such as enabling, predisposing and need factors. Evidence from the study is consistent with interpersonal continuity or a regular, trusting relationship with a primary care provider, which transcends over time, resulting in better health outcomes and lower cost to the health care system. The results also provide evidence that the reported macro-level benefits of a well-structured primary health care can be demonstrated using the individual as the unit of analysis, in terms of reductions in health care utilization and lower costs. By reducing specialist visits, continuity of care may also reduce the likelihood of unnecessary diagnostic and therapeutic interventions and adverse events.

The findings were confirmed in two separate samples and are consistent with most research examining the relationship of continuity of care with health care utilization and costs. Evidence is especially strong for an association of higher continuity with a reduction in hospitalizations for ACSCs and hospital costs given that the relationship also persisted in a longitudinal analysis. The association of continuity with ACSCs and a stronger association in the elderly, suggests the mechanism through which continuity of care exerts its apparent protective effects may involve improved prevention, secondary prevention, treatment and /or management of chronic illness, which may have "increased importance" in older people (Menec et al., 2006).

These findings provide evidence that policy should promote continuity of FP care and that mechanisms to maintain or enhance traditional continuity of FP should continue to be incorporated into any primary health care reform initiatives. This is especially true for vulnerable populations, for which continuity of care may have increased importance, such as the elderly and chronically ill. This evidence is especially important in a time when FPs in solo- and small-group practice are increasingly being replaced by teams of primary health care providers. The study provides new knowledge in that it is one of the first to demonstrate increased importance of continuity of FP care in older people by conducting separate analyses for different age groups, the first in a general primary health care sample of hospitalized individuals, as well as by the use of more appropriate regression techniques than are used in many previous studies. In addition, the study adds to the evidence that the relationship of continuity of care with reduced health care services utilization and costs reported in many US studies exists in Canada in a universal health care system free of user fees. Also, the study provides evidence that this relationship can be demonstrated over a longer time period than in most previous studies, which is important given the slow progressive nature of many chronic illnesses. Finally, the study results are consistent with a newly- proposed modified model of health services used, based on Andersen's model, incorporating continuity of care as measured by a visit-based index of continuity of FP care and controlling for FP utilization.

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APPENDICES

Appendix A: Descriptions of Variables Extracted from CCHS (Phase I Sample)

CCHS Variables

Variable Grouping	Variable	Description
Administrative	Respondent ID	• Unique identifier for survey respondent; • Combination of household ID and person ID
	Survey Date	• Date on which respondent was interviewed for the survey
Socio-demographics	Age	• Age in years
	Gender	• Male or Female
	Marital Status	• Categories: Married, common-law, widowed, separated, divorced, single
	Rural/Urban Status	• Derived by Statistics Canada from community of residence of respondent: • Categories: Urban, Rural • An urban area is defined as a continuously built-up area having a population concentrate of 1000 or more and a population density of 400 or more per square km based on the 1996 Census. Continuously built-up area means that it must not have a discontinuity exceeding two km.
	Income	• Income quartile: Lower income quartile, Lower middle income quartile, Upper middle income quartile, Upper income quartile (based on total household income and number of people living in the household)
Lifestyle	Smoking Status	• How often the respondent smokes: • Categories: Daily, occasionally, Not at all
	Physical Activity Index	• Derived by Statistics Canada from questions asked about the respondent's daily physical activity (based on estimated energy expenditure) • Categories: Active, Moderately active, Inactive
	Drinking Status (Alcohol)	• How often the respondents drinks • Categories: Regular drinker, Occasional drinker, Former drinker, Never drank
	Fruit and Vegetable Consumption	• Respondent's Daily consumption of total fruits and vegetables: • Less than 5 servings per day, 5 servings or more per day
Health Status	Number of Chronic Conditions	• This variable is the total number of health conditions (mostly chronic illnesses), which the respondents self-reported. They only include long-term serious conditions that have lasted or are expected to last 6 months or more and that have been diagnosed by a health professional. • Respondents were asked specifically whether they had the any of the following health conditions (mostly chronic illnesses):

Variable Grouping	Variable	Description
		• Food allergies, any other allergies, asthma, fibromyalgia, arthritis or rheumatism, back problems excluding arthritis and fibromyalgia, high blood pressure, migraine headaches, chronic bronchitis or emphysema or chronic obstructive pulmonary disease, diabetes, epilepsy, heart disease, cancer, stomach or intestinal ulcers, effects of a stroke, urinary in continence, a bowel disease (Crohn's or colitis), Alzheimers's disease or other dementia, cataracts, glaucoma a thyroid condition , any other long-term condition that has been diagnosed by a health professional • For arthritis or rheumatism respondents were asked if they suffered from rheumatoid arthritis, osteoarthritis or other • For heart disease respondents were also asked if they had suffered a heart attack, angina or congestive heart failure • For cancer respondents were asked specific cancers (breast, prostate, colorectal, skin cancer (melanoma and non melanoma) or other type

Note that due to small numbers within categories, especially at the 55+ and 65+ age groups, categories for the following CCHS variables were collapsed into a smaller number of categories as follows:

Marital Status - Two categories: Categorized as 'Partnered' (Married/common law) or 'Unpartnered' (widowed/divorced/separated/single)

Income Level - Two categories: Categorized as 'Lower two income quartiles' (lower income quartile, lower middle income) and 'Upper two income quartiles' (upper middle income quartile, upper income quartile)

Smoking Status - Two categories: Categorized as 'Daily/occasionally' and 'Not at all'.

Drinking Status (Alcohol) - Two categories: Categorized as 'Regular Drinker' or 'Occasional/former drinker/ never drank'

Appendix B: Relevant Study Variables - Medical Care Plan (MCP) Databases

Variables from MCP Registration File (Phase II Sample)

Label	Description
Health Insurance Number	Patient's MCP number
Date of Birth	Patient's Date of Birth
Postal Code	Patient's Postal Code of Residence

Variables from MCP Physician Claims File (Phases I and II)

Label	Description
Health Insurance Number	Patient's MCP number
Age	Age on January 1st, 1999
Sex	Sex
Provider ID	Unique identifier of physician
Specialty code	Provider's specialty (001 = FP), (other = specialist)
Diagnosis code	Diagnostic code to describe reason for physician encounter (ICD-9 code)
Service date	Date service rendered
Fee code	Fee code used to describe specific service provided. Services are divided into 8 categories (See below)
Fee claimed (cost)	Amount claimed for service performed
Premium amount	Amount of additional charges

Notes:

1) Specialist code ranges from 001 (for FP) to 82 and include all specialties

2) Fee code is categorized into: Office, Home, in-patient, out-patient/emergency, diagnostic and therapeutic procedures, in-hospital diagnostic procedures, radiology, and surgical procedures

3) Fee claimed is as per Medical Care Plan, Department of Health and Community Services, Government of Newfoundland and Labrador

4) Sometimes an additional charge is claimed for certain services

Appendix C: Relevant Study Variables - Clinical Database Management System (CDMS) (Hospital Separations) (Phase I and II)

Variables from the Clinical Database Management System (CDMS)

Variable Name	Description
Health Insurance Number	Health Insurance Number
Fiscal Year	Fiscal year
Care episode ID	Unique hospitalization identifier
Diagnosis code	ICD-9 or ICD-10 diagnoses code (most responsible diagnosis only)
Resource intensity weight	Numeric value used by the Canadian Institute for Health Information to classify a hospitalization by resource use and is used in cost estimation (Cost per weighted case methodology). It is based on typical resources used based on most-responsible diagnosis, co-morbidities and age (See Appendix G)
Community	
Region of Residence	

Note:

Only acute care (in-patient) hospitalizations were used in the current study

Appendix D: Study Design (Phase I)

Methodology (Phase I)

Newfoundland and Labrador CCHS Sample (2000/01)
(~3700 individuals age 12+)

Record linkage by MCP Number

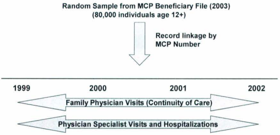
+/- 2 years from CCHS Survey Date

Family Physician Visits (Continuity of Care)

Physician Specialist Visits and Hospitalizations

Appendix E: Study Design (Phase II)

Methodology (Phase 2)



Appendix F: Formula for Calculation of Continuity of Care Index

Continuity of care index (COC) = $$\frac{\sum_{j=1}^{S} n_j^2 - N}{N(N-1)}$$

Measure sensitive to total number of visits and their distribution across different providers *(Bice and Boxerman, 1977)*

where n = total number of visits, n_j = number of visits to provider j and s= number of providers

Appendix G: CIHI Costing Methodology for Acute (Inpatient) Hospital Data

A Resource Intensity Weight (RIW) is an indicator which is a quantitative value representing the expected relative resource use by a patient during a hospital stay. RIWs are adjusted for several factors known to affect hospital costs such as age, the presence of additional co-morbidities and/or type and number of procedures undergone. The sum of all the RIWs for a group of patients (e.g. in a particular health service or program) is referred to as the "Weighted Cases" for that service or program. Cost per Weighted Case (CPWC) is calculated and updated annually by the Canadian Institute for Health Information (CIHI) and provides a measure of the average financial cost a facility incurs to treat a single inpatient. It is calculated by dividing the net total inpatient cost for a hospital by the total weighted cases in that facility. Average values are also calculated for the provinces. Once the average CPWC has been calculated, the average total costs for treating these patients can be obtained by multiplying by the Total Weighted Cases.

Estimate of Total Costs = CPWC X Total Weighted Cases

(Taken from: The Costs of Hospital Stays: Why Costs Vary (Canadian Institute for Health Information, 2008)

For the present study, total inpatient costs were calculated by summing the RIWs for each hospitalization incurred by patients in the study sample and multiplying by the average CPWC value for 2001 for Newfoundland and Labrador ($4512) provided in the in the Hospital Financial Performance Indicators 1998-2003 document (produced by the Canadian Institute of Health Information (Canadian Institute for Health Information, 2004)). Similar methodology was used in a recent study of continuity of family practice and health care cost for people with chronic illness in British Columbia, Canada (Hollander et al., 2009)

Appendix H: Andersen's Model of Health Services Utilization

To guide the current research in the choice of variables and statistical analysis conducted, a modified version of Andersen's conceptual model of the use of health services was used (Andersen, 1995). The model suggests that an individual's use of health services is a function of several parameters: population characteristics (i.e., predisposition to use services, factors enabling (or impeding) health care use, and need for care); the health care system (e.g., existent health policy and available resources), and the individual's external environment. According to Andersen's model, mainly three types of factors determine health services contacts: predisposing factors, enabling factors and need factors. According to the authors, in order for use of health services to take place (1) an individual must be predisposed to receive medical care (2) there are enabling conditions that allow the individual to attain health services and (3) the individual must perceive a need for these services. Predisposing factors include variables such as gender, age and social status. Enabling factors include conditions that facilitate or inhibit the use of physician services such as the distance to the health centre, the type of municipality, working time, family size, and health insurance coverage. Need variables include the presence or absence of chronic diseases, disability days, or measures of well-being. Here, continuity of FP care can be thought of as an enabling factor.

In the models of health services and cost outcomes used in the current study, there is at least one variable from each of the population predisposing enabling factor and need categories. The analysis using the Canadian Community Health Survey sample also has variables from the health behaviours catego

Appendix I: Serious Health Conditions Used for "Chronic Conditions" Variable

Serious Heath Conditions Used for "Chronic Conditions" Variable

Health Condition	ICD-9 Codes	ICD-10 Codes
Asthma	493	J45
Hypertension	401	I10
Migraine headaches	346	G43
Chronic obstructive pulmonary disease	490–492, 496	J40–J44
Epilepsy	345	G40
Acute myocardial infarction	410	I21–I22
Angina	413	I20
Heart failure	428	I50
Stomach or intestinal ulcers	531–534	K25–K28
Stroke	430–432, 434,438	I60–I64
Bowel disorder	555–556, 558	K50–K52
Alzheimer's disease	331	G30–G32
Thyroid condition	240–246	E00–E07
Parkinson's disease	332	G20
Multiple sclerosis	340	G35
Arthritis	274, 446 710-721 725-729	M00-M19 M23–M24, M30–M34, M35.0-M35.3 M45–M47, M48.0-M48.1 M49, M65, M68, M76 M70.0, M71.2 M75.0 M77.2-M77.9
Diabetes	250	E10-E14
Cancer	140–208	C00–C97

Appendix J: Approval Documentation

Ethics Approval

MEMORIAL
UNIVERSITY

Faculty of Medicine

ENTERED NOV 0 6 2007

November 5, 2007

FILE COPY

<u>Reference #07.90</u>

Mr. John Knight
c/o Dr. V. Gadag
Division of Community health
Faculty of Medicine

SHIPPED NOV 0 6 2007

Dear Mr. Knight:

This will acknowledge your correspondence dated, October 31, 2007, wherein you clarify issues for your research study entitled **"Association of Continuity of Family Physician Care with Health-related Outcomes in Elderly People with Chronic Conditions in Newfoundland and Labrador".**

At the meeting held on May 24, 2007, the initial review date of this study, the Human Investigation Committee (HIC) agreed that the response could be reviewed by the Co-Chairs and, if found acceptable, full approval of the study be granted.

The Co-Chairs of the HIC reviewed your correspondence, and, under the direction of the Committee, granted ***full approval*** of your research study. This will be reported to the full Human Investigation Committee, for their information at the meeting scheduled for November 8, 2007.

Full approval has been granted for one year. You will be contacted to complete the annual form update approximately 8 weeks before the approval will lapse on May 24, 2008. It is your responsibility to ensure that the renewal form is forwarded to the HIC office not less than 30 days prior to the renewal date for review and approval to continue the study. The annual renewal form can be downloaded from the HIC website <u>http://www.med.mun.ca/hic/downloads/Annual%20Update%20Form.doc</u>.

<u>The Human Investigation Committee advises THAT IF YOU DO NOT return the completed annual update form prior to or on the aforementioned date of renewal;</u>

* *Your ethics approval will lapse*
* *You will be required to stop research activity*

* *You will not be permitted to restart the study until you reapply for and receive approval to undertake the study again*

In addition, the Human Investigation Committee will inform the appropriate authorities. To ensure proper action is taken; the appropriate officials will be notified to terminate funding.

Modifications of the protocol/consent are not permitted without prior approval from the Human Investigation Committee. Implementing changes in the protocol/consent without HIC approval may result in the approval of your research study being revoked, necessitating cessation of all related research activity. Request for modification to the protocol/consent must be outlined on an amendment form (available on the HIC website) and submitted to the HIC for review.

For a hospital-based study, it is **your responsibility to seek the necessary approval from Eastern Health and/or other hospital boards as appropriate**.

This Research Ethics Board (the HIC) has reviewed and approved the application and consent form for the study which is to be conducted by you as the qualified investigator named above at the specified study site. This approval and the views of this Research Ethics Board have been documented in writing. In addition, please be advised that the Human Investigation Committee currently operates according to the Tri-Council Policy Statement and applicable laws and regulations. The membership of this research ethics board complies with the membership requirements for research ethics boards defined in Division 5 of the Food and Drug Regulations.

Notwithstanding the approval of the HIC, the primary responsibility for the ethical conduct of the investigation remains with you.

We wish you every success with your study.

Sincerely,

John D. Harnett, MD, FRCPC
Co-Chair
Human Investigation Committee

Richard S. Neuman, PhD
Co-Chair
Human Investigation Committee

JDH;RSN\jed

C Dr. C. Loomis, Vice-President (Research), MUN
Mr. W. Miller, Senior Director, Corporate Strategy & Research, Eastern Health

Letters of Approval from Data Custodians

Centre for Health Information
Newfoundland & Labrador

1 Crosbie Place, St. John's, NL A1B 3Y8
Telephone: 709-757-2400 • Facsimile: 709-757-2411

Registry Integrity Unit, P.O. Box 5800, Taylor Building
Old Carbonear Road, Harbour Grace, NL A0A 2M0
Telephone: 709-945-5335 • Facsimile: 709-945-5340

February 12, 2007

Mr. John Knight
PhD Candidate
c/o Dr. Veeresh Gadag
Division of Community Health
Faculty of Medicine
Memorial University of Newfoundland

Dear Mr. Knight:

I am writing in support of your study which proposes to investigate the association between continuity of family physician care, health care services utilization, costs and health outcomes. The Centre will allow use of the Clinical Database Management System Data for your study and provide data linkage and de-identification services in support of the study once the following conditions are met with approval:

1) HIC application (MUN)
2) Privacy Impact Assessment (NLCHI)
3) Confidentiality Aggreement (NLCHI)
4) Letters of Support (Data Custodians)
5) Comment from the Office of the Information and Privacy Commissioner

The Centre for Health Information looks forward to working with you on this important study and wishes you every success in your research.

Sincerely,

Don MacDonald
Director, Research and Evaluation

CC: Dr. Veeresh Gadag

Newfoundland Labrador

Government of Newfoundland and Labrador
Department of Health and Community Services

March 30, 2007

Mr. John Knight
PhD Candidate
c/o Dr. Veeresh Gadag
Division of Community Health
Faculty of Medicine
Memorial University of Newfoundland
Health Sciences Centre
St. John's, NL A1B 3V6

Dear Mr. Knight:

I am writing in support of your research study entitled *"Association of Continuity of Family Physician Care with Health Care Service Utilization, Health Status and Costs in Elderly People with Chronic Conditions in Newfoundland and Labrador"*.

The Department of Health and Community Services recognizes the importance studying the relationship of continuity of care with health care services utilization and health outcomes. I approve the use of the Canadian Community Health Survey Share file (Cycle 1.1) for your study as well as the use of the Link ID by NLCHI to carry out the required data linkage for purposes of the project. It is understood that all data will be de-identified before being used in the research study.

Sincerely,

Joy Maddigan

JOY MADDIGAN
Assistant Deputy Minister
Policy & Planning Branch

P.O. Box 8700, St. John's, NL, Canada A1B 4J6 t 709.729.3103 f 709.729.0121 website: www.gov.nl.ca

Newfoundland Labrador

Government of Newfoundland and Labrador
Department of Government Services

RECEIVED

MAY 17 2007

Centre for Health Information

May 14, 2007

Mr. Don MacDonald
Director, Research and Evaluation
Newfoundland and Labrador Centre for Health Information
28 Pippy Place
St. John's, NL A1B 3X4

Dear Mr. MacDonald:

I am writing in response to your email dated February 12, 2007, regarding Mr. John Knight's proposed study entitled "***Association of Continuity of Family Physician Care with Health Care Service Utilization, Costs and Self-Perceived Health Status in Elderly People with Chronic Conditions in Newfoundland and Labrador.***"

This Division recognizes the importance of studying the relationship of continuity of family physician care with a variety of health system outcomes. For the purposes of this study, I support your request for the use of the Mortality Data files by NLCHI staff to carry out the proposed linkage. It is understood that prior to accessing mortality data for this study, a copy of the letter of approval from the Human Investigations Committee at Memorial University will be forward to my attention and you will await final departmental approval of your request. Once the linkage has been carried out, all personal identifiers will be stripped from the database prior to being provided to Mr. John Knight.

Yours sincerely,

Brenda Andrews

BRENDA ANDREWS
Registrar
Vital Statistics Division

BA/dk

Newfoundland
Labrador

Government of Newfoundland and Labrador
Department of Health and Community Services

RECEIVED

FEB 16 2007

Centre for Health Information

February 14, 2007

Mr. Don MacDonald
Director, Research and Evaluation
Newfoundland and Labrador Centre for Health Information
1 Crosbie Place
St. John's NL A1B 3Y8

Dear Mr. MacDonald:

I am writing in support of Mr. John Knight's study entitled ***"Association of Continuity of Family Physician Care with Health Care Service Utilization, Costs and Self-Perceived Health Status in Elderly People with Chronic Conditions in Newfoundland and Labrador"***.

The Newfoundland and Labrador Medical Care Plan (MCP) recognizes the importance in studying the relationship of continuity of family physicians with a variety of health system outcomes. For the purpose of this study, I approve access to the MCP database maintained by NLCHI for the NDSS to carry out the proposed linkage. It is understood that once the linkage has been carried out, all personal identifiers will be stripped from the database prior to being provided to Mr. John Knight.

Sincerely,

TONY MAHER, C.A.
Executive Director
Audit & Claims Integrity Division

c. Mr. John Knight

Belvedere Building, 57 Margaret's Place
P.O. Box 8700, St. John's, NL, Canada A1B 4J6
Telephone: (709)758-1599 Facsimile: (709)758-1575

Privacy Impact Assessment

August 9, 2006

Newfoundland & Labrador
Centre for Health Information

Newfoundland and Labrador Centre for Health Information
Research and Evaluation Division

Privacy Impact Assessment Form

The Research and Evaluation team works closely with local, provincial, and national research organizations such as Memorial University of Newfoundland and Health Canada in carrying out applied health research. As a regular activity, Research and Evaluation Division provides researchers with aggregate data. If a researcher requires person-identifying data, NLCHI requires the completion of a Privacy Impact Assessment (PIA) and approval by a research ethics board before approval is sought from the data custodian(s).

To ensure that the confidentiality of individuals is maintained, NLCHI is committed to conducting PIAs for all of its activities, including research using person-identifying information. The completed PIA provides evidence that privacy issues associated with the research project, and other activities, have been identified and best efforts have been made to resolve or mitigate any risk to the privacy of the individual.

NLCHI maintains several person specific databases on behalf of the provincial health system. More information on these databases is available at www.nlchi.nf.ca. NLCHI will require written authorization from the custodial government department before it releases person identifying data.

Personal Information is defined in the Access to Information and Protection of Privacy Act (ATIPP) as any recorded information about an identifiable individual. This can include, but is not limited to:
1) an individual's name, address, and telephone number.
2) an individual's race, national or ethnic origin, religious or political beliefs or associations.
3) an individual's are, sex, sexual orientation, marital status or family status.
4) an individual's identifying marks, numbers, symbols, or other particulars.
5) an individual's fingerprints, blood type, inheritable characteristics.
6) an individual's health information such as status, history, and physical or mental disabilities.
7) an individual's educational, financial, criminal, or employment history and status.
8) an individual's personal opinions.
9) the opinions of others regarding an individual.

Guidelines and Procedures:

This privacy impact assessment form is meant to identify the privacy risks associated with the research's request of personal information. All individuals have a right to privacy, and their personal information must be protected with this in mind. In requesting access to data, it is vital that you identify a need for the personal data you have requested, how you will protect it, and how you will address security issues. The Newfoundland and Labrador Centre for health Information uses ATIPP's 10 privacy principles as a guide to ensure the privacy of the personal information when it is in our custody and when it is in the possession of researchers. The 10 privacy principles correspond with the sections of this form. Our expectations under these guidelines consist of the following:

1. Accountability: NLCHI requires that researchers demonstrate responsibility for personal information under it's control, and designate a person who is accountable for the security, use, and disclosure of personal information.
2. Identifying purposes: NLCHI requires that all purposes requiring access to data be disclosed, and that a need is demonstrated.
3. Consent: NLCHI requires that all researchers obtain consent for data prior to its use.*
4. Limiting collection: NLCHI requires that data collection be limited to the specific needs of the project.
5. Limiting use, disclosure, access and retention: NLCHI requires that data not be disclosed for any purposes other than those for which consent has been granted, and that information be kept only for the approved period.
6. Accuracy and Integrity: NLCHI requires researchers to show how they will ensure the accuracy of the information which they receive.
7. Security safe guards: NLCHI requires organizational, physical, and technical measures for the protection of personal information.
8. Openness of policies, procedures and practicies: NLCHI requires that researchers disclose their policies and practices in regards to how they handle personal information.
9. Individual access: NLCHI requires that personal information be accessible, upon request, to those whom it belongs.
10. Challenging compliance: NLCHI requires that researchers demonstrate how they will receive and handle challenges or complaints about their practices.

Procedural Guide:

In order to successfully complete your application for access to information you must follow these steps.

- ✓ Contact Research and Evaluation/Privacy Division: This should be done to ensure the requested data is available, and to clarify any other questions you may have about the information we can provide.
- ✓ Complete the PIA form: Indicate, in each section, the ways in which you will comply to the above guidelines.
- ✓ Submit this form to a Research Ethics Board (REB): This form must be included with your application when you apply for ethical clearance.
- ✓ Once REB approval is granted, contact Research and Evaluation for data access, to sign data sharing agreement form and confidentiality form.

1. Accountability

A) Please indicate who will be accountable for data security and enforcement of the time frame.		
Name	Position	Contact information
John Knight	PhD Candidate	757-2434 johnk@nlchi.nl.ca

B) Participants

Include contact information of all individuals, i.e. name, position, telephone number, and email. Indicate what data they will have access to from NLCHI. Note: It is the investigators' responsibility to notify NLCHI of new hires.

Name:	Position:	Contact Information:	Type of data access	
			All data	De-identified
John Knight	PhD Student, Division of Community Health, MUN	757-2434 johnk@nlchi.nl.ca		X
Dr. Veeresh Gadag	Professor, Division of Community Health, MUN	777-6221 vgadag@mun.ca		X

2. Identifying Purposes

A) Project Information	Anticipated Start Date: November, 2007

Project title and brief description: (you must attach a detailed proposal or REB application)
Project Title: **Association of Continuity of Family Physician Care with Health-related Outcomes in Elderly People with Chronic Conditions in Newfoundland and Labrador**

B) Risk Assessment
a) Were there any alternative methods considered that might be less privacy-invasive for achieving the desired objective? If so, why were these rejected? **No.**
b) Describe the ways this study might identify, stigmatize, or otherwise harm patients, practitioners, and/ or institutions, in any publications or presentation of results, and your strategies to mitigate these. **None (data will be de-identified)**
c) What is the rationale for this study, i.e., why are you doing this study? **The current study will use data in the Newfoundland sample of the Canadian Community Health Survey and administrative health services databases to study the relationship of continuity of care with health care service utilization and other health-related outcomes while accounting for effects of covariate variables such as socio-demographics and health status in Newfoundland and Labrador. We will also examine the effect of age on the relationship of continuity with these outcomes.** **Most of the work examining the relationship between continuity of care and patient outcomes has been done on pediatric or adult populations. Although elderly people/people with chronic**

conditions have been found to value continuity of care more than younger people, it is uncertain whether better continuity of care for older people is associated with better health outcomes and satisfactions levels.

In addition, as most studies of continuity of care have been done in the US, more research is needed to examine benefits of continuity of care in a universally-funded health care system where access barriers are fewer, as is the case in Canada.

We recently completed a pilot study examining the relationship of continuity of care of family physician care with hospitalization in Diabetics using the same administrative databases that will be used for this study. We found that it was feasible to use these databases to study the relationship between continuity and the above outcomes and we found that continuity of care was associated with decreased likelihood of hospitalization. However, the MCP database used for the pilot had a limited number of variables to use as co-variates in our study. The present study will incorporate the Canadian Community Health Survey which has a wealth of variables such as health status, socio-economic and lifestyle variables and thus will allow examination of the relationship between continuity of care and outcomes while controlling for these important co-variates.

d) Please identify any secondary uses of the data.

None.

C) Ethics Approval

This completed PIA must be included with any request for ethics approval.

Which research ethics board will you be submitting this to?

Human Investigations Committee (MUN)

If ethics approval was received from a REB outside Newfoundland, was NLCHI identified as a data source. If so please attach a copy of the application and letter of approval. If no, explain why not.

Yes.

3. Consent

A) Data Requested

Indicate all databases from which you require information, including the variables, and date range.

Databases	Date Range: mm/yyyy - mm/yyyy	Variables (attach if necessary)
Clinical Database Management System (CDMS)	1999-2002	See Protocol
Newfoundland Medical Care Plan (MCP)	1999-2002	See Protocol
National Diabetes Surveillance System (MDSS)		
Canadian Community Health Survey	2000/01	See Protocol
National Population Health Survey		
Live Birth System		
Mortality System	1999-2006	See Protocol
Other: Please		

B) List all personal information from other sources that you will be linking to the requested personal information from NLCHI (i.e., health number, date of birth).

None (all data sources will be de-identified and provided to the research team by NLCHI).

C) If you have signed consent from the individuals participating in the study, please attach a copy of each one.

N/A

4. Limiting Collection

NLCHI requires that you collect only that personal information which is needed for your purposes. Any unneeded personal information should be returned to NLCHI.

5. Limiting Use, Disclosure, Access and Retention

NLCHI requires that the provided data is used only for the purposes disclosed in section 2, disclosed only to those indicated in section 1.

Please describe or attach all policies which describe how you will ensure these conditions are met.

Only individuals listed in Section 1 will have access to data.

6. Accuracy and integrity

What precautions or policies do you have in place to assure the accuracy of the information you will use in your research?

Data will be obtained from provincial data custodians and such will already have undergone data quality checks.

7. Security Safe Guards

All personal information must be protected by administrative, technical, and physical safeguards to prevent unauthorized access to personal information.   T Please describe or attach the security policies you have in place for each of the requirements below.

A) Administrative:
Do you require that all employees sign confidentiality agreements?   **Yes. A copy of the confidentiality agreement which the researcher must sign is attached.**
Do you provide your employees with training in privacy standards?   **Yes. Employees are required to complete privacy training and follow privacy Guidelines as described in the NLCHI Policy Manual**
What are your disposal policies for shredding and destruction of data?   **All paper is disposed of in a secure manner and shredding by a secure paper-shredding contractor. Data is erased from computers and CDs are disposed of in a secure manner.**

B) Technical:
In the event of unauthorized access, will your safeguards detect how the breach occurred and by whom?   **Yes.**
Password access for computers containing data: **Computer containing data is password protected.**

Automatic shutdown and password request on resume:

Yes.

Regular password changes:

Computer passwords are regularly changed.

File back-up Policy:

A back-up copy of files are retained on CD in a locked filing cabinet.

C) Physical:

NLCHI requires that all information be stored on * Computer

Data is stored on a computer

NLCHI does not allow for the transmission of personal information over wireless networks.

No wireless networks associated with computer containing data.

Is the building containing personal information received from NLCHI secure (locked doors and cabinets, surveillance), and does it require key card access?

Yes, data will be kept on a computer and on a CD in a filing cabinet both in a looked room located in a building secured by security doors

What measures for security are being enacted for the long term storage of data?

Data deleted from computer after completion of study and stored in a locked filing cabinet for 5 years.

d) Other: Please indicate if you have other safety measures not included in the above sections.
Nil.

8. Openness of Policies, Procedures and Practices
NLCHI requires that you make available to individuals specific information about policies and procedures for the management of personal information.

9. Individual Access
What policies do you have to ensure that individuals can, upon request, be informed of their information which is being held? **N/A**

10. Challenging Compliance
Your procedures and policies must be open to scrutiny and challenge. How do you plan on allowing individuals to challenge your policies and procedures? Who is going to be accountable for compliance? **N/A**

Researcher Signature:	John Knight
Date: dd/mm/yyyy	01/06/2007

Confidentiality Agreement

Newfoundland & Labrador
Centre for Health Information

CONFIDENTIALITY AGREEMENT

You have been provided with personal, identifiable record-level data from the Newfoundland and Labrador Centre for Health Information for purposes of the research study entitled:

Association of Continuity of Family Physician Care with Health-related Outcomes in Elderly People with Chronic Conditions in Newfoundland and Labrador

Use of this data is restricted solely to the aforementioned research study. You are responsible for keeping confidential all data provided (written or computerized) which is accessed, handled, or viewed by you over the duration of the research study. Communication of, or access to, such information by people other than study personnel[1] or employees of the Centre, is strictly prohibited. The data provided as per this agreement is to be returned to the Centre and all copies made are to be deleted/destroyed at the end of the research study.

I have read and reviewed the above confidentiality agreement and understand that the data provided to me is not to be communicated to anyone, in any manner, except as specified above.

NAME: (Please print) John Knight

SIGNED: John Knight

WITNESSED: Maureen Harvey

DATED: November 15, 2007

Comment from the Office of the Information and Privacy Commissioner

HOUSE OF ASSEMBLY

FILE COPY

OFFICE OF THE INFORMATION AND PRIVACY COMMISSIONER
P.O. Box 13004, Station A, 34 Pippy Place, St. John's, NL A1B 3V8
Telephone: (709) 729-6309 Facsimile: (709) 729-6500 E-mail: commissioner@oipc.nl.ca

March 23, 2009

Mr. John Knight
Doctoral Candidate
c/o Dr. Veeresh Gadag
Division of Community Health
Faculty of Medicine
Memorial University
St. John's, NL
A1B 3V6

Dear Mr. Knight:

Subject: Thesis Proposal

This will acknowledge receipt on March 4, 2009 of your correspondence dated March 4, 2009 enclosing a copy of your Thesis Proposal and attached approval documents. You propose to study the relationship of continuity of family physician care with health care service utilization, costs and health outcomes in elderly people with chronic conditions in Newfoundland and Labrador.

Your proposal outlines a study that will use data in the Newfoundland and Labrador sample of the Canadian Community Health Survey (CCHS) which will be linked by MCP number to three administrative health services databases maintained by the Newfoundland and Labrador Centre for Health Information (NLCHI) as follows:

(1) Medical Care Plan (MCP) Claims File
(2) Clinical Database Management System (CDMS)
(3) Mortality Surveillance System (MSS).

You have received written support from NLCHI for your study and NLCHI has consented to your use of the CDMS. In addition, NLCHI has agreed to provide data linkage and de-identification services in support of your study once the following conditions are met with approval:

(a) Human Investigation Committee (MUN)
(b) Privacy Impact Assessment (NLCHI)
(c) Confidentiality Agreement (NLCHI)
(d) Letters of Support from Data Custodians
(e) Comment from the Office of the Information and Privacy Commissioner.

You have provided our Office with a copy of the initial approval for your research study granted by Memorial University's Human Investigation Committee on November 5, 2007, and with the approval renewal indicating that the next renewal date is November 1, 2009.

You have received a letter dated March 30, 2007, from Ms. Joy Maddigan, Assistant Deputy Minister of Health and Community Services, approving your use of the data from the Canadian Community Health Survey (CCHS) and approving the data linkage for the purposes of your study.

A letter dated February 14, 2007, from Mr. Tony Maher, Executive Director of the Audit & Claims Integrity Division of the Department of Health and Community Services, authorizes NLCHI to access the MCP Database maintained by NLCHI for the purposes of your study.

In correspondence dated May 14, 2007, Ms. Brenda Andrews, Registrar of the Vital Statistics Division of the Department of Government Services authorizes NLCHI to access the Mortality Data files for the purpose of carrying out the data linkage for your study.

It is the understanding of this Office that all personal identifiers (such as names) will be removed and/or modified (such as changing a birth date to age) by NLCHI staff and the resulting anonymous data will be used for analysis. A study ID number will serve as a unique identifier for individuals. In addition, all study data will be stored in a locked office at NLCHI, both on a stand-alone, password protected computer and on CD.

In my telephone call to you on Friday, March 20th, you clarified the purpose of certain information required during the data extraction phase. In particular, you indicated that the community names and postal codes of patients whose information will be extracted will only be used in order for NLCHI to ascertain for the purposes of your study which regional health authority the patient falls under, however the postal codes and community names will not be available to you as the researcher.

Based on my understanding of your Thesis Proposal, and the other noted approvals, this Office is pleased with the measures that have been taken to protect the personal information of the individuals included in your study sample.

The observations provided here are given pursuant to paragraph (c) of section 51 of the *Access to Information and Protection of Privacy Act* which allows this Office to comment on the implications for the protection of privacy of using or disclosing personal information for record linkage and using information technology in the collection, storage, use or transfer of personal information.

I thank you for contacting the Office of the Information and Privacy Commissioner and wish you success in your important research study.

I trust all of the above is in order.

Yours truly,

Sean Murray
Assistant Commissioner (A)

Appendix K: Ambulatory Care Sensitive Conditions (ACSCs)

ICD codes used for ACSCs were as follows:

Any most responsible diagnosis code of:

- **Grand mal status and other epileptic convulsions**

  ICD-9: 345**ICD-10-CA**: G40, G41

- **Chronic obstructive pulmonary diseases (COPD)**

  - Any most responsible diagnosis (MRDx) code of:

  ICD-9: 491, 492, 494, 496
  ICD-10-CA: J41, J42, J43, J44, J47

  - MRDx of Acute lower respiratory infection, only when a secondary diagnosis[1] of J44 in ICD-10-CA or 496 in ICD-9 is also present

  ICD-9: 480 - 486, 466, 487.0
  ICD-10-CA: *J10.0, J11.0, J12-J16, J18, J20, J21, J22*

- **Asthma**

  ICD-9: 493
  ICD-10-CA: J45

- **Diabetes**

  ICD-9: 250.0, 250.1, 250.2, 250.7
  ICD-10-CA: E10.0^^, E10.1^^, E10.63, E10.9^^

  E11.0^^, E11.1^^, E11.63, E11.9^^
  E13.0^^, E13.1^^, E13.63, E13.9^^
  E14.0^^, E14.1^^, E14.63, E14.9^^

- **Heart failure and pulmonary oedema***

  ICD-9: 428, 518.4
  ICD-10-CA: I50, J81

  *Excluding cases with cardiac procedures

- **Hypertension***

  ICD-9: 401.0, 401.9, 402.0, 402.1, 402.9
  ICD-10-CA: I10.0, I10.1, I11
  *Excluding cases with cardiac procedures

- **Angina***

  ICD-9: 411, 413
  ICD-10-CA: I20, I23.82, I24.0, I24.8, I24.9
  *Excluding cases with cardiac procedures

***List of cardiac procedures:**

- Repair/reconstruction of heart valves (pulmonary, mitral, aortic, annulus NEC and structures adjacent to the valves)
- Transplant heart with lungs
- Implantation/removal pacemaker
- Destruction/repair/excision partial/removal foreign body heart
- Procurement/excision/repair of pericardium or endocardium or epicardium
- Implantation/adjustment/repositioning of pacemaker leads
- Ablation cardiac conduction system
- Extraction/repair atrium
- Bypass/reattachment right heart structures
- Sivision/repair/excision of interatrial septum
- Bypass/repair/reattachment/construction of interventricular septum
- Transfer aorta with pulmonary aorta and coronary arteries
- Bypass/repair/dilatation/angioplasty coronary arteries
- Removal device coronary arteries
- Extraction/excision partial coronary veins
- Construction/reconstruction pulmonary vein
- Construction/reconstruction aorta with pulmonary artery with interventricular septum
- Construction/reconstruction interventricular septum with interarterial septum with heart valves
- Construction/reconstruction interventricular septum with pulmonary valve with aorta with right ventricle
- Repositioning of battery

***Codes for cardiac procedures:**

CCP: 47^^, 480^-483^, 4891, 4899, 492^-495^, 497^, 498^

CCI: 1HA58, 1HA80, 1HA87, 1HB53, 1HB54, 1HB55, 1HB87, 1HD53, 1HD54, 1HD55, 1HH59, 1HH71, 1HJ76, 1HJ82, 1HM57, 1HM78, 1HM80, 1HN71, 1HN80, 1HN87, 1HP76, 1HP78, 1HP80, 1HP82, 1HP83, 1HP87, 1HR71, 1HR80, 1HR84, 1HR87, 1HS80, 1HS90, 1HT80, 1HT89, 1HT90, 1HU80, 1HU90, 1HV80, 1HV90, 1HW78, 1HW79, 1HX71, 1HX78, 1HX79, 1HX80, 1HX83, 1HX86, 1HX87, 1HY85, 1HZ53 rubric (**except** 1HZ53LAKP), 1HZ54, 1HZ55 rubric (**except** 1HZ55LAKP), 1HZ56, 1HZ57, 1HZ59, 1HZ80, 1HZ85, 1HZ87, 1IF83, 1IJ50, 1IJ54GQAZ, 1IJ55, 1IJ57, 1IJ76, 1IJ80, 1IK57, 1IK87, 1IN84, 1LA84, 1LC84, 1LD84, 1YY54LANJ

Notes:

1) The most responsible is the most significant condition during the patient hospitalization and the one diagnosis which uses up most resources during the hospitalizations.

A new "combination" code for acute lower respiratory infections in patients with Chronic Obstructive Pulmonary Disease (J44) was introduced with ICD-10-CA and has no equivalents in ICD-9/ICD-9-CM. Cases coded with a primary diagnosis of an acute lower respiratory infection and a secondary diagnosis of J44 in ICD-10-CA or 496 in ICD-9/9CM will be included in the COPD case count. This was undertaken to ensure that COPD cases with acute lower respiratory infections are captured in ICD-9/CM jurisdictions in the same fashion, as they would be in ICD-10-CA jurisdictions, and to compensate for evident erroneous non-application of the combination code in ICD-10-CA jurisdictions.

[1] "Secondary diagnosis" refers to a diagnosis other than most responsible.

[2] Code may be recorded in any position. Procedures coded as cancelled, previous and "abandoned after onset" are excluded.

(Canadian Institute for Health Information, 2009)

Appendix L: Procedure Used to Calculate Continuity of Care Index

Step A) Preliminary file preparation:

1) Link CCHS (Phase I) or MCP registry file (Phase II) to MCP claims file

2) Select FP visits (i.e. speciality code '001')

3) Select records with Capacity = '0' only (vast majority of records)

4) Use Compute to create a variable called 'provnum1' which is just a copy of the 'provnum' field.

5) Name the file 'FP visit'

Step B) Make the following files from the 'FP visit' file using the 'aggregate' function:

File #1: Total FP visits (aggregated by mcp/respond_id)

fields:

Respond_id CCHS Respondent ID (unique identifier from CCHS 1.1 for Phase I or unique ID replacing MCP number for Phase II)

tot_vsts: total FP visits per patient

tot_1: total FP visits per patient - 1

tot_tot1: tot_vsts * total_1

File #2: Visits per FP (aggregated by respond_id /ID replacing MCP number and provnum)

fields:

Respond_id CCHS Respondent ID/ID replacing MCP number for Phase II

provnum: unique provider ID

vsts_fp: visits per FP

sq_vsts: square of visits per FP

Step C) Make the following file from the 'Visits per FP' file using the aggregate function aggregated by respond_id/ID replacing MCP number:

File #3: Sum_of_square_of_GP_visits

fields:

respond_id: CCHS Respondent ID/ID replacing MCP number for Phase II

sum_sq: sum of squares of visits per FP for each patient

Link files 1, 3 and 4 via CCHS respondent ID (Phase I) or ID replacing MCP number (Phase II)

Step D) Calculation of COC

Use transform compute to make a field called 'sum_tot' as follows:

Sum_tot = sum_sq – tot_vsts

Then use transform compute to compute COC as follows:

COC = sum_tot / tot_tot1

Step E) Link resulting file to main study data file (either CCHS or MCP registry study file as appropriate)

Step F) Missing Values:

1) Insert '0's where number of GP visits is blank (i.e. these people had no visits).

2) Insert '9999's for CoC index values where # of GP visits is less than 3.

3) Put '9' in the 'discrete missing values' box under the 'missing values' property of the CoC index variables

Appendix M: Descriptive Statistics by Age Group (for Age Groups Other than 12+)

Phase I: CCHS Sample (Continuity and Outcomes measured of Same Four-year Period)

Table M1: Socio-demographics by Continuity of Care Level (Age 55+) (N=678)

Characteristic	Low Continuity COC < 0.5	Medium Continuity 0.5≤COC<0.75	High Continuity COC ≥ 0.75	Total[1]	p-value
	[Count (%)]				
n (% of Sample)	99 (14.6)	121 (17.8)	458 (67.6)	678 (100)	--
Gender					
Male	37 (42.5)	41 (38.7)	184 (45.9)	262 (44.1)	0.393
Female	50 (57.5)	65 (61.3)	217 (54.1)	332 (55.9)	
Age (years)					
Mean (SD)	64.84 (8.73)	67.10 (9.14)	66.84 (8.99)	66.60 (8.99)	0.059
Age Groups					
12-19	--	--	--	--	--
20-44	--	--	--	--	--
45-64	46 (52.9)	47 (44.3)	182 (45.5)	275 (46.4)	0.770
65-74	27 (31.0)	38 (35.8)	140 (35.0)	205 (34.6)	
75+	14 (16.1)	21 (19.8)	78 (19.5)	113 (19.1)	
Marital Status					
Partnered	65 (74.7)	72 (68.6)	281 (70.1)	418 (70.5)	0.617
Un-partnered	22 (25.3)	33 (31.4)	120 (29.9)	175 (29.5)	
Income Adequacy					
Lower two income quartiles	43 (52.4)	66 (65.3)	248 (65.1)	357 (63.3)	0.087
Upper two income quartiles	39 (47.6)	35 (34.7)	133 (34.9)	207 (36.7)	
Rural/Urban					
Urban	53 (60.9)	75 (70.8)	260 (64.8)	388 (65.3)	0.338
Rural	34 (39.1)	31 (29.2)	141 (35.2)	206 (34.7)	

[1] Totals may not sum to 678 due to sample weighting and/or missing data

Table M2: Life-Style Characteristics by Continuity of Care Level (Age 55+) (N=678)

Characteristic	Low Continuity COC < 0.5 (N=99)	Medium Continuity 0.5≤COC<0.75 (N=121)	High Continuity COC≥0.75 (N=458)	Total[1] (N=678)	p-value
	[Count (%)]				
Smoking					
Daily/Occasionally	11 (12.6)	18 (17.1)	80 (20.0)	109 (18.4)	0.258
Not at all	76 (87.4)	87 (82.9)	320 (80.0)	483 (81.6)	
Drinking					
Regular Drinker	29 (33.3)	28 (26.7)	148 (37.0)	205 (34.6)	0.135
Occasional/Former Drinker/Never Drank	58 (66.7)	77 (73.3)	252 (63.0)	387 (65.4)	
Physical Activity					
Active/Moderately Active	24 (28.6)	33 (31.4)	110 (28.5)	167 (29.0)	0.837
Inactive	60 (71.4)	72 (68.6)	276 (71.5)	408 (71.0)	
Fruit and Vegetable Consumption					
Less than 5 daily Servings	64 (74.4)	64 (60.4)	248 (62.3)	376 (63.7)	0.078
5 or more daily Servings	22 (25.6)	42 (39.6)	150 (37.7)	214 (36.3)	

[1] Totals may not sum to 678 due to sample weighting and/or missing data

Table M3: Health Status Characteristics by Continuity of Care Level (Age 55+) (N=678)

Characteristic	Low Continuity COC < 0.5 (N=99)	Medium Continuity 0.5≤COC<0.75 (N=121)	High Continuity COC ≥ 0.75 (N=458)	Total[1] (N=678)	p-value
	[Count (%)]				
Number of Chronic Conditions					
Mean (SD)	2.00 (1.60)	2.10 (1.78)	2.16 (1.68)	2.12 (1.68)	0.959
0	16 (18.4)	21 (19.8)	60 (15.0)	97 (16.3)	0.776
1	20 (23.0)	23 (21.7)	94 (23.4)	137 (23.1)	
2+	51 (58.6)	62 (58.5)	247 (61.6)	360 (60.6)	
FP Visits					
(Home and office)					
Number of FP Visits					
Mean (SD)	19.92 (16.41)	22.76 (15.71)	23.98 (17.95)	23.17 (17.38)	0.064
3-10	30 (34.5)	23 (21.7)	80 (20.0)	133 (22.4)	0.033
11-20	24 (27.6)	27 (25.5)	128 (31.9)	179 (30.1)	
21+ FP	33 (37.9)	56 (52.8)	193 (48.1)	282 (47.5)	

[1] Totals may not sum to 678 due to sample weighting and/or missing data

Table M4: Socio-demographics by Continuity of Care Level (Age 65+) (N=377)

Characteristic	Low Continuity COC < 0.5	Medium Continuity 0.5≤COC<0.75	High Continuity COC ≥ 0.75	Total[1]	p-value
	[Count (%)]				
n (% or Sample)	49 (13.0)	66 (17.5)	262 (69.5)	377 (100)	--
Gender					
Male	16 (39.0)	23 (39.0)	98 (44.7)	137 (42.9)	0.629
Female	25 (61.0)	36 (61.0)	121 (55.3)	182 (57.1)	
Age (years)					
Mean (SD)	72.88 (5.73)	73.76 (6.46)	73.50 (6.62)	73.47 (6.47)	0.886
Age Groups					
12-19	--	--	--	--	--
20-44	--	--	--	--	--
45-64	--	--	--	--	--
65-74	27 (65.9)	38 (64.4)	140 (64.2)	205 (64.5)	0.980
75+	14 (34.1)	21 (35.6)	78 (35.8)	113 (35.5)	
Marital Status					
Partnered	24 (58.5)	38 (64.4)	132 (60.3)	194 (60.8)	0.804
Un-partnered	17 (41.5)	21 (35.6)	87 (39.7)	125 (39.2)	
Income Adequacy					
Lower two income quartiles	26 (65.0)	43 (79.6)	157 (77.0)	226 (75.8)	0.209
Upper two income quartiles	14 (35.0)	11 (20.4)	47 (23.0)	72 (24.2)	
Rural/Urban					
Urban	22 (55.0)	39 (66.1)	142 (65.1)	203 (64.0)	0.440
Rural	18 (45.0)	20 (33.9)	76 (34.9)	114 (36.0)	

[1] Totals may not sum to 377 due to sample weighting and/or missing data

Table M5: Life-Style Characteristics by Continuity of Care Level (Age 65+) (N=377)

Characteristic	Low Continuity COC < 0.5 (N=49)	Medium Continuity 0.5≤COC<0.75 (N=66)	High Continuity COC ≥ 0.75 (N=262)	Total[1] (N=377)	p-value
	[Count (%)]				
Smoking					
Daily/Occasionally	3 (7.3)	6 (10.2)	29 (13.3)	38 (11.9)	0.498
Not at all	38 (92.7)	53 (89.8)	189 (86.7)	280 (88.1)	
Drinking					
Regular Drinker	5 (12 .5)	10 (16.9)	72 (33.0)	87 (27.4)	0.004
Occasional/Former Drinker/Never Drank	35 (87.5)	49 (83.1)	146 (67.0)	230 (72.6)	
Physical Activity					
Active/Moderately Active	9 (24.3)	14 (24.1)	52 (25.2)	75 (24.9)	0.981
Inactive	28 (75.7)	44 (75.9)	154 (74.8)	226 (75.1)	
Fruit and Vegetable Consumption					
Less than 5 daily Servings	31 (75.6)	34 (57.6)	133 (61.6)	198 (62.7)	0.158
5 or more daily Servings	10 (24.4)	25 (42.4)	83 (38.4)	118 (37.3)	

[1] Totals may not sum to 377 due to sample weighting and/or missing data

Table M6: Health Status Characteristics by Continuity of Care Level (Age 65+) (N=377)

Characteristic	Low Continuity COC < 0.5 (N=49)	Medium Continuity 0.5≤COC<0.75 (N=66)	High Continuity COC ≥ 0.75 (N=262)	Total[1] (N=377)	p-value
	[Count (%)]				
Number of Chronic Conditions					
Mean (SD)	2.05 (1.32)	2.33 (1.95)	2.47 (1.76)	2.39 (1.75)	0.598
0	4 (10.0)	9 (15.5)	27 (12.4)	40 (12.7)	
1	9 (22.5)	14 (24.1)	38 (17.4)	61 (19.3)	
2+	27 (67.5)	35 (60.3)	153 (70.2)	215 (68.0)	
FP Visits (Home and office only)					
Number of FP Visits Mean (SD)	22.12 (16.83)	24.23 (15.93)	25.11 (17.41)	24.56 (17.05)	0.731
3-10	11 (26.8)	12 (20.3)	38 (17.4)	61 (19.2)	0.135
11-20	12 (29.3)	10 (16.9)	69 (31.7)	91 (28.6)	
21+	18 (43.9)	37 (62.7)	111 (50.9)	166 (52.2)	

[1] Totals may not sum to 377 due to sample weighting and/or missing data

Phase II: MCP Sample Cross-sectional Analysis
(Continuity and Outcomes Measured of Same Four-year Period)
First Set of Age Groups

Table M7: Socio-demographics by Continuity of Care Level, Continuity and Outcomes over 4 years (1999-2002); Ages 55+ (N=14,107)

Characteristic	Low Continuity COC < 0.5	Medium Continuity 0.5≤COC<0.75	High Continuity COC ≥ 0.75	Total	p-value
	[Count (%)]				
n (% of Sample)	2570 (18.2)	2674 (19.0)	8863 (62.8)	14,107 (100)	--
Gender					
Male	1088 (42.3)	1122 (42.0)	4328 (48.8)	6538 (48.8)	<0.000
Female	1482 (57.7)	1552 (58.0)	4535 (51.2)	7569 (51.2)	
Age (years) Mean (SD)	68.34 (9.63)	68.00 (9.42)	67.87 (9.08)	67.98 (9.25)	
Age Groups					
12-19	--	--	--	--	--
20-44	--	--	--	--	--
45-64	--	--	--	--	--
65-74	1538 (59.8)	1668 (62.4)	5449 (61.5)	8655 (61.4)	0.156
75+	1032 (40.2)	1006 (37.6)	3414 (38.5)	5452 (38.6)	
Income Quintile					
1 (Low)	392 (16.5)	445 (18.0)	1536 (18.6)	2373 (18.1)	<0.000
2	494 (20.8)	440 (17.8)	1677 (20.4)	2611 (19.9)	
3	468 (19.7)	569 (23.0)	1824 (22.1)	2861 (21.8)	
4	564 (23.7)	519 (20.9)	1762 (21.4)	2845 (21.7)	
5 (High)	461 (19.4)	505 (20.4)	1439 (17.5)	2405 (18.4)	
Rural/Urban					
Urban	1293 (50.7)	1284 (48.6)	4476 (50.9)	7053 (50.5)	0.106
Rural	1255 (49.3)	1358 (51.4)	4314 (49.1)	6927 (49.5)	
Number of Chronic Conditions					
Mean (SD)	2.46 (1.62)	2.42 (1.55)	2.28 (1.47)	2.34 (1.52)	<0.001
0	192 (7.5)	198 (7.4)	693 (7.8)	1083 (7.7)	
1	607 (23.6)	588 (22.0)	2232 (25.2)	3427 (24.3)	
2+	1771 (68.9)	1888 (70.6)	5938 (67.0)	9597 (68.0)	
Number of FP Visits (Mean (SD))	24.05 (19.91)	25.63 (20.69)	25.47 (23.50)	25.24 (22.37)	<0.001
3-10	692 (26.9)	542 (20.3)	2004 (22.6)	3238 (23.0)	<0.001
11-20	690 (26.8)	808 (30.2)	2529 (28.5)	4027 (28.5)	
21+	1188 (46.2)	1324 (49.5)	4330 (48.9)	6842 (48.5)	

Table M8: Socio-demographics by Continuity of Care Level, Continuity and Outcomes over 4 years (1999-2002); Ages 65+ (N=7898)

Characteristic	Low Continuity COC < 0.5	Medium Continuity 0.5≤COC<0.75	High Continuity COC ≥ 0.75	Total	p-value
	[Count (%)]				
n (% of Sample)	1457 (18.4)	1470 (18.6)	4971 (62.9)	7898 (100)	--
Gender					
Male	603 (41.4)	592 (40.3)	2286 (46.0)	3481 (44.1)	<0.001
Female	854 (58.6)	878 (59.7)	2685 (54.0)	4417 (55.9)	
Age (years)					
Mean (SD)	75.11 (7.146)	74.85 (7.095)	74.37 (6.654)	74.59 (6.837)	0.006
Age Groups					
12-19	--	--	--	--	--
20-44	--	--	--	--	--
45-64	--	--	--	--	--
65-74	788 (54.1)	815 (55.40	2913 (58.6)	4516 (57.2)	0.003
75+	669 (45.9)	655 (44.6)	2058 (41.4)	3382 (42.8)	
Income Quintile					
1 (Low)	229 (17.0)	245 (17.9)	841 (18.2)	1315 (17.9)	<0.001
2	274 (20.3)	229 (16.8)	973 (21.0)	1476 (20.1)	
3	257 (19.1)	322 (23.6)	1032 (22.3)	1611 (22.0)	
4	329 (24.4)	279 (20.4)	962 (20.8)	1570 (21.4)	
5 (High)	259 (19.2)	290 (21.2)	817 (17.7)	1366 (18.6)	
Rural/Urban					
Urban	737 (50.9)	702 (48.2)	2477 (50.3)	3916 (50.0)	0.296
Rural	712 (49.1)	753 (51.8)	2444 (49.7)	3909 (50.0)	
Number of Chronic Conditions					
Mean (SD)	2.77 (1.677)	2.69 (1.614)	2.51 (1.532)	2.59 (1.578)	<0.001
0	81 (5.6)	77 (5.2)	283 (5.7)	441 (5.6)	0.035
1	269 (18.5)	273 (18.6)	1063 (21.4)	1605 (20.3)	
2+	1107 (76.0)	1120 (76.2)	3625 (72.9)	5852 (74.1)	
Number of FP Visits	26.01 (21.69)	27.69 (22.50)	27.51 (24.35)	27.27 (23.55)	<0.006
Mean (SD)					
3-10	369 (25.3)	272 (18.5)	978 (19.7)	1619 (20.5)	
11-20	360 (24.7)	406 (27.6)	1330 (26.8)	2096 (26.5)	
21+	728 (50.0)	792 (53.9)	2663 (53.6)	4183 (53.0)	

Table M9: Socio-demographics by Continuity of Care Level, Continuity and Outcomes over 4 years (1999-2002); Ages 75+ (N=3382)

Characteristic	Low Continuity COC < 0.5	Medium Continuity 0.5≤COC<0.75	High Continuity COC ≥ 0.75	Total	p-value
	[Count (%)]				
n (% of Sample)	669 (19.8)	655 (19.3)	2058 (60.9)	3382 (100)	--
Gender					
Male	238 (35.6)	234 (35.7)	853 (41.4)	1325 (39.2)	0.003
Female	431 (64.4)	421 (64.3)	1205 (58.6)	2057 (60.8)	
Age (years)					
Mean (SD)	81.52 (5.04)	81.43 (4.91)	80.96 (4.63)	81.16 (4.78)	0.027
Age Groups					
12-19	--	--	--	--	--
20-44	--	--	--	--	--
45-64	--	--	--	--	--
65-74	--	--	--	--	--
75+	669 (100.0)	655 (100.0)	2058 (100.0)	3382 (100.0)	--
Income Quintile					
1 (Low)	104 (16.9)	112 (18.4)	335 (17.4)	551 (17.5)	0.077
2	103 (16.7)	108 (17.7)	407 (21.2)	618 (19.6)	
3	132 (21.5)	138 (22.6)	420 (21.8)	690 (21.9)	
4	145 (23.6)	113 (18.5)	396 (20.6)	654 (20.8)	
5 (High)	131 (21.2)	139 (22.8)	366 (19.0)	636 (20.2)	
Rural/Urban					
Urban	318 (48.0)	316 (48.7)	1034 (50.7)	1668 (49.8)	0.381
Rural	345 (52.0)	333 (51.3)	1004 (49.3)	1682 (50.2)	
Number of Chronic Conditions					
Mean (SD)	2.92 (1.74)	2.82 (1.61)	2.60 (1.58)	2.71 (1.62)	<0.001
0	39 (5.8)	34 (5.2)	112 (5.4)	185 (5.5)	0.036
1	111 (16.6)	102 (15.6)	419 (20.4)	632 (18.7)	
2+	519 (77.6)	519 (79.2)	1527 (74.2)	2565 (75.8)	
Number of FP Visits					
Mean (SD)	28.07 (24.88)	29.14 (24.35)	29.58 (27.91)	29.20 (26.67)	0.211
3-10	165 (24.7)	119 (18.2)	412 (20.0)	696 (20.6)	0.026
11-20	153 (22.9)	176 (26.9)	495 (24.1)	824 (24.4)	
21+	351 (52.5)	360 (55.0)	1151 (55.9)	1862 (55.1)	

Phase II: MCP Sample Cross-sectional Analysis
(Continuity and Outcomes Measured of Same Four-year Period)
Second Set of Age Groups

Table M10: Co-variates by Continuity of Care Level, Continuity and Outcomes over 4 years (1999-2002); Ages 12-19 (N=5413)

Characteristic	Low Continuity COC < 0.5	Medium Continuity 0.5≤COC<0.75	High Continuity COC ≥ 0.75	Total	p-value
	[Count (%)]				
n (% of Sample)	2478 (45.8)	1176 (21.7)	1759 (32.5)	5413 (100)	--
Gender					
Male	971 (39.2)	479 (40.7)	858 (48.8)	2308 (42.8)	<0.001
Female	1509 (60.8)	697 (59.3)	901 (51.2)	3107 (57.4)	
Age (years)					
Mean (SD)	16.18 (2.31)	15.80 (2.34)	15.61 (2.29)	15.91 (2.32)	<0.001
Income Quintile					
1 (Low)	299 (12.6)	142 (12.8)	230 (13.7)	671 (13.0)	<0.001
2	300 (12.7)	156 (14.0)	299 (17.8)	755 (14.6)	
3	470 (19.9)	230 (20.7)	341 (20.3)	1041 (20.2)	
4	683 (28.9)	304 (27.3)	459 (27.3)	1446 (28.0)	
5 (High)	613 (25.9)	280 (25.2)	350 (20.8)	1243 (24.1)	
Rural/Urban					
Urban	812 (33.0)	426 (36.5)	651 (37.3)	1889 (35.2)	0.008
Rural	1649 (67.0)	742 (63.5)	1093 (62.7)	3484 (64.8)	
Number of Chronic Conditions					
Mean (SD)	0.67 (0.82)	0.66 (0.80)	0.58 (0.75)	0.64 (0.80)	0.001
0	1239 (50.0)	599 (50.9)	965 (54.9)	2803 (51.8)	0.005
1	915 (36.9)	421 (35.8)	615 (35.0)	1951 (36.0)	
2+	326 (13.1)	156 (13.3)	179 (10.2)	661 (12.2)	
Number of FP Visits					
(Mean (SD)	12.44 (10.23)	13.46 (9.92)	11.41 (10.17)	12.33 (10.17)	
3-10 FP	1374 (55.4)	563 (47.9)	1093 (62.1)	3030 (56.0)	<0.001
11-20 FP	716 (28.9)	405 (34.4)	433 (24.6)	1554 (28.7)	
21+ FP	390 (15.7)	208 (17.7)	233 (13.2)	831 (15.3)	

Table M11: Co-variates by Continuity of Care Level, Continuity and Outcomes over 4 years (1999-2002); Ages 20-44 (N=21,427)

Characteristic	Low Continuity COC < 0.5	Medium Continuity 0.5≤COC<0.75	High Continuity COC ≥ 0.75	Total	p-value
		[Count (%)]			
n (% of Sample)	6930 (32.3)	4754 (22.1)	9743 (45.5)	21,427 (100)	--
Gender					
Male	2815 (40.6)	1847 (38.8)	4233 (43.4)	8895 (41.5)	<0.001
Female	4114 (59.4)	2908 (61.2)	5512 (56.6)	12,534 (58.5)	
Age (years)					
Mean (SD)	32.32 (7.15)	33.56 (6.96)	34.74 (6.78)	33.70 (7.02)	<0.001
Income Quintile					
1 (Low)	795 (12.2)	609 (13.6)	1435 (15.6)	2839 (14.0)	<0.001
2	1027 (15.7)	704 (15.7)	1653 (17.9)	3384 (16.7)	
3	1292 (19.8)	953 (21.3)	1979 (21.5)	4224 (20.9)	
4	1722 (26.4)	1126 (25.1)	2170 (23.5)	5018 (24.8)	
5 (High)	1699 (26.0)	1092 (24.4)	1980 (21.5)	4771 (23.6)	
Rural/Urban					
Urban	2593 (37.8)	1955 (41.6)	4189 (43.3)	8737 (41.1)	<0.001
Rural	4272 (62.2)	2746 (58.4)	5481 (56.7)	12,499 (58.9)	
Number of Chronic Conditions					
Mean (SD)	0.96 (1.00)	1.05 (1.05)	0.98 (1.01)	0.99 (1.02)	<0.001
0	2652 (38.3)	1643 (34.6)	3604 (37.0)	7899 (36.9)	<0.001
1	2576 (37.2)	1834 (38.6)	3741 (38.4)	8151 (38.0)	
2+	1701 (24.5)	1278 (26.9)	2400 (24.6)	5379 (25.1)	
Number of FP Visits					
Mean (SD)	16.08 (15.61)	17.78 (15.79)	16.53 (16.45)	16.66 (16.05)	<0.001
3-10 FP Visits	3149 (45.4)	1801 (37.9)	4394 (45.1)	9344 (43.6)	<0.001
11-20 FP Visits	1989 (28.7)	1507 (31.7)	2772 (28.4)	6268 (29.3)	
21+ FP Visits	1791 (25.8)	1447 (30.4)	2579 (26.5)	5817 (27.1)	

Table M12: Co-variates by Continuity of Care Level, Continuity and Outcomes over 4 years (1999-2002); Ages 45-64 (N=15,757)

Characteristic	Low Continuity COC < 0.5	Medium Continuity 0.5≤COC<0.75	High Continuity COC ≥ 0.75	Total	p-value
	[Count (%)]				
n (% of Sample)	3257 (20.6)	3224 (20.5)	9276 (58.9)	15,757 (100)	--
Gender					
Male	1390 (42.7)	1385 (43.0)	4718 (50.9)	7493 (47.6)	<0.001
Female	1867 (57.3)	1839 (57.0)	4558 (49.1)	8264 (8264)	
Age (years)					
Mean (SD)	52.94 (5.54)	53.51 (5.54)	53.91 (5.58)	53.63 (5.58)	<0.001
Income Quintile					
1 (Low)	460 (15.2)	494 (16.4)	1553 (18.0)	2507 (17.1)	<0.001
2	574 (19.0)	550 (18.3)	1688 (19.6)	2812 (19.2)	
3	607 (20.1)	643 (21.3)	1874 (21.7)	3124 (23.3)	
4	739 (24.5)	734 (24.4)	1939 (22.5)	3412 (23.3)	
5 (High)	641 (21.2)	591 (19.6)	1577 (18.3)	2809 (19.2)	
Rural/Urban					
Urban	1585 (49.1)	1496 (46.8)	4625 (50.2)	7706 (49.3)	0.005
Rural	1641 (50.9)	1698 (53.2)	4592 (49.8)	7931 (50.7)	
Number of Chronic Conditions					
Mean (SD)	1.70 (1.31)	1.78 (1.31)	1.74 (1.28)	1.74 (1.29)	0.016
0	531 (16.3)	456 (14.1)	1417 (15.3)	2404 (15.3)	0.053
1	1105 (33.9)	1061 (32.9)	3041 (32.8)	5207 (33.0)	
2+	1621 (49.8)	1707 (52.9)	4818 (51.9)	8146 (51.7)	
Number of FP Visits					
Mean (SD)	19.53 (18.81)	21.68 (17.50)	21.24 (19.95)	20.98 (19.19)	<0.001
3-10	1125 (34.5)	847 (26.3)	2827 (30.5)	4799 (30.5)	<0.001
11-20	1006 (30.9)	1063 (33.0)	2895 (31.2)	4964 (31.5)	
21+	1126 (34.6)	1314 (40.8)	3554 (38.3)	5994 (38.0)	

Table M13: Co-variates by Continuity of Care Level, Continuity and Outcomes over 4 years (1999-2002); Ages 65-74 (N=4520)

Characteristic	Low Continuity COC < 0.5	Medium Continuity 0.5≤COC<0.75	High Continuity COC >= 0.75	Total	p-value
		[Count (%)]			
n (% of Sample)	789 (17.5)	816 (18.1)	2915 (64.5)	4520 (100)	--
Gender					
Male	365 (46.3)	358 (43.9)	1433 (49.2)	2156 (47.7)	0.020
Female	423 (53.7)	457 (56.1)	1480 (50.8)	2360 (52.3)	
Age (years)					
Mean (SD)	69.66 (2.86)	69.55 (2.92)	69.72 (2.85)	69.68 (2.86)	0.310
Income Quintile					
1 (Low)	125 (17.1)	133 (17.6)	506 (18.7)	764 (18.2)	<0.001
2	171 (23.3)	121 (16.0)	566 (21.0)	858 (20.5)	
3	125 (17.1)	184 (24.4)	612 (22.7)	921 (22.0)	
4	184 (25.1)	166 (22.0)	566 (21.0)	916 (21.9)	
5 (High)	128 (17.5)	151 (20.0)	451 (16.7)	730 (17.4)	
Rural/Urban					
Urban	419 (53.3)	386 (47.9)	1443 (50.1)	2248 (50.2)	0.092
Rural	367 (46.7)	420 (52.1)	1440 (49.9)	2227 (49.8)	
Number of Chronic Conditions					
Mean (SD)	2.64 (1.62)	2.59 (1.61)	2.44 (1.50)	2.50 (1.54)	0.011
0	42 (5.3)	43 (5.3)	171 (5.9)	256 (5.7)	0.617
1	158 (20.1)	171 (21.0)	644 (22.1)	973 (21.5)	
2+	588 (74.6)	601 (73.7)	2098 (72.0)	3287 (72.8)	
Number of FP Visits					
Mean (SD)	24.26 (18.40)	26.53 (20.83)	26.04 (21.37)	25.82 (20.79)	
3-10	204 (25.9)	153 (18.8)	566 (19.4)	923 (20.4)	0.001
11-20	207 (26.3)	230 (28.2)	835 (28.7)	1272 (28.2)	
21+	377 (47.8)	432 (53.0)	1512 (51.9)	2321 (51.4)	

Phase II: MCP Sample Longitudinal Analysis (Continuity and Outcomes Measured from 1999-2000 and Outcomes measured from 2001-2002) First Set of Age Groups

Table M14: Socio-demographics by Continuity of Care Level, Continuity (1999-2000) and Outcomes (2001-2002); Ages 55+ (N=12,876)

Characteristic	Low Continuity COC < 0.5	Medium Continuity 0.5≤COC<0.75	High Continuity COC ≥ 0.75	Total	p-value
		[Count (%)]			
n (% of Sample)	2049 (15.9)	2168 (16.8)	8659 (67.2)	12,876 (100)	--
Gender					
Male	837 (40.8)	936 (43.2)	4066 (47.0)	5839 (45.3)	<0.001
Female	1212 (59.2)	1232 (56.8)	4593 (53.0)	7037 (54.7)	
Age (years)					
Mean (SD)	68.3 (9.68)	68.4 (9.33)	68.2 (9.18)	68.2 (9.28)	0.666
Age Groups					
12-19	--	--	--	--	--
20-44	--	--	--	--	--
45-64	--	--	--	--	--
65-74	1243 (60.7)	1295 (59.7)	5214 (60.2)	7752 (60.2)	0.826
75+	806 (39.3)	873 (40.3)	3445 (39.8)	5124 (39.8)	
Income Quintile					
1 (Low)	341 (18.0)	343 (17.2)	1428 (17.7)	2112 (17.6)	0.075
2	361 (19.1)	366 (18.3)	1640 (20.3)	2367 (19.8)	
3	426 (22.5)	438 (21.9)	1767 (21.9)	2631 (22.0)	
4	431 (22.8)	430 (21.5)	1781 (22.1)	2542 (22.1)	
5 (High)	335 (17.7)	423 (21.2)	1460(18.1)	2218 (18.5)	
Rural/Urban					
Urban	1050 (51.8)	1039 (48.4)	4251 (49.5)	6340 (49.7)	0.078
Rural	977 (48.2)	1107 (51.6)	4333 (50.5)	6417 (50.3)	
Number of Chronic Conditions					
Mean (SD)	2.39 (1.57)	2.56 (1.57)	2.40 (1.48)	2.43 (1.51)	<0.001
0	154 (7.5)	119 (5.5)	521 (6.0)	794 (6.2)	0.001
1	478 (23.3)	443 (20.4)	2025 (23.4)	2946 (22.9)	
2+	1417 (69.2)	1606 (74.1)	6113 (70.6)	9136 (71.0)	
Number of FP Visits	13.66 (11.09)	15.15 (11.23)	15.00 (14.94)	14.81 (13.5)	<0.001
Mean (SD)					
3-6	568 (27.7)	423 (19.5)	1931 (22.3)	2922 (22.7)	<0.001
7-10	459 (22.4)	465 (21.4)	1964 (22.7)	2888 (22.4)	
11+	1022 (49.9)	1280 (59.0)	4764 (55.0)	7066 (54.9)	

Table M15: Socio-demographics by Continuity of Care Level, Continuity (1999-2000) and Outcomes (2001-2002); Ages 65+ (N=7365)

Characteristic	Low Continuity COC < 0.5	Medium Continuity 0.5≤COC<0.75	High Continuity COC ≥ 0.75	Total	p-value
		[Count (%)]			
n (% of Sample)	1145 (15.5)	1253 (17.0)	4967 (67.4)	7365 (100)	--
Gender					
Male	457 (39.9)	518 (41.3)	2243 (45.2)	3218 (43.7)	0.001
Female	688 (60.1)	735 (58.7)	2724 (54.8)	4147 (56.3)	
Age (years)					
Mean (SD)	75.19 (7.19)	74.74 (6.98)	74.55 (6.73)	74.68 (6.85)	0.069
Age Groups					
12-19	--	--	--	--	<0.001
20-44	--	--	--	--	
45-64	--	--	--	--	
65-74	339 (29.6)	380 (30.3)	1522 (30.6)	2241 (30.4)	0.787
75+	806 (70.4)	873 (69.7)	3445 (69.4)	5124 (69.6)	
Income Quintile					
1 (Low)	198 (18.8)	195 (16.9)	810 (17.5)	1203 (17.6)	0.007
2	196 (18.6)	200 (17.3)	974 (21.0)	1370 (20.0)	
3	230 (21.8)	261 (22.6)	1023 (22.1)	1514 (22.1)	
4	252 (23.9)	244 (21.1)	982 (21.2)	1478 (21.6)	
5 (High)	180 (17.0)	255 (22.1)	845 (18.2)	1280 (18.7)	
Rural/Urban					
Urban	601 (52.9)	577 (46.5)	2427 (49.4)	3605 (49.4)	0.009
Rural	536 (47.1)	663 (53.5)	2490 (50.6)	3689 (50.6)	
Number of Chronic Conditions					
Mean (SD)	2.69 (1.65)	2.77 (1.62)	2.62 (1.54)	2.66 (1.57)	0.017
0	64 (5.8)	57 (4.5)	221 (4.4)	342 (4.6)	0.161
1	215 (18.8)	218 (17.4)	984 (19.8)	1417 (19.2)	
2+	866 (75.6)	978 (78.1)	3762 (75.7)	5606 (76.1)	
Number of FP Visits	14.76 (11.94)	16.09 (11.88)	16.28 (14.12)	16.01 (13.45)	<0.001
Mean (SD)					
3-10 FP	275 (24.0)	219 (17.5)	924 (18.6)	1418 (19.3)	<0.001
11-20 FP	264 (23.1)	248 (19.8)	1058 (21.3)	1570 (21.3)	
21+ FP	606 (52.9)	786 (62.7)	2985 (60.1)	4377 (59.4)	

Table M16: Socio-demographics by Continuity of Care Level, Continuity (1999-2000) and Outcomes (2001-2002); Ages 75+ (N=3,192)

Characteristic	Low Continuity COC < 0.5	Medium Continuity 0.5≤COC<0.75	High Continuity COC ≥ 0.75	Total	p-value
		[Count (%)]			
n (% of Sample)	527 (16.5)	548 (17.2)	2117 (66.3)	3192 (100)	
Gender					
Male	179 (34.0)	206 (37.6)	861 (40.7)	1246 (39.0)	0.014
Female	348 (66.0)	342 (62.4)	1256 (59.3)	1946 (61.0)	
Age (years)					
Mean (SD)	81.7 (5.02)	81.3 (4.90)	81.0 (4.69)	81.2 (4.79)	0.046
Age Groups					
12-19	--	--	--	--	
20-44	--	--	--	--	
45-64	--	--	--	--	
65-74	--	--	--	--	
75+	527 (16.5)	548 (17.2)	2117 (66.3)	3192 (100)	
Income Quintile					
1 (Low)	89 (18.3)	90 (17.8)	335 (16.9)	514 (17.3)	0.281
2	84 (17.2)	84 (16.6)	407 (20.6)	575 (19.4)	
3	112 (23.0)	110 (21.7)	433 (21.9)	655 (22.1)	
4	106 (21.8)	101 (20.0)	417 (21.1)	624 (21.0)	
5 (High)	96 (19.7)	121 (23.9)	385 (19.5)	602 (20.3)	
Rural/Urban					
Urban	268 (51.2)	243 (44.8)	1045 (49.9)	1556 (49.2)	0.067
Rural	255 (48.8)	299 (55.2)	1050 (50.1)	1604 (50.8)	
Number of Chronic Conditions					
Mean (SD)	2.81 (1.68)	2.85 (1.66)	2.71 (1.58)	2.75 (1.61)	0.142
0	31 (5.9)	27 (4.9)	100 (4.7)	158 (4.9)	0.483
1	93 (17.6)	87 (15.9)	395 (18.7)	575 (18.0)	
2+	403 (76.5)	434 (79.2)	1622 (76.6)	2459 (77.0)	
Number of FP Visits					
Mean (SD)	15.59 (12.55)	18.10 (14.01)	17.90 (16.67)	17.56 (15.64)	0.001
3-6 FP	118 (22.4)	88 (16.1)	371 (17.5)	577 (18.1)	0.001
7-10	116 (22.0)	86 (15.7)	415 (19.6)	617 (19.3)	
11+	293 (55.6)	374 (68.2)	1331 (62.9)	1998 (62.6)	

Phase II: MCP Sample Longitudinal Analysis
(Continuity and Outcomes Measured from 1999-2000 and Outcomes measured from 2001-2002)
Second Set of Age Groups

Table M17: Co-variates by Continuity of Care Level, Continuity (1999-2000) and Outcomes (2001-2002); Ages 12-19 (N=4154)

Characteristic	Low Continuity COC < 0.5	Medium Continuity 0.5≤COC<0.75	High Continuity COC ≥ 0.75	Total	p-value
	[Count (%)]				
n (% of Sample)	1693 (40.7)	860 (20.7)	1601 (38.5)	4154 (100)	--
Gender					
Male	640 (37.8)	329 (38.3)	691 (43.2)	1660 (39.9)	0.004
Female	1055 (62.2)	531 (61.7)	531 (56.8)	910 (60.1)	
Age (years)					
Mean (SD)	16.27 (2.34)	16.04 (2.33)	15.74 (2.24)	16.02 (2.31)	<0.001
Income Quintile					
1 (Low)	201 (12.5)	92 (11.2)	209 (13.7)	502 (12.7)	0.004
2	204 (12.7)	107 (13.0)	255 (16.7)	566 (14.3)	
3	323 (20.0)	168 (20.4)	315 (20.6)	806 (20.4)	
4	459 (28.5)	252 (30.6)	416 (27.3)	1127 (28.5)	
5 (High)	424 (26.3)	204 (24.8)	331 (21.7)	959 (24.2)	
Rural/Urban					
Urban	560 (33.3)	281 (32.9)	587 (37.0)	1428 (34.7)	0.040
Rural	1120 (66.7)	573 (67.1)	998 (63.0)	2691 (65.3)	
Number of Chronic Conditions Mean (SD)	0.76 (0.85)	0.80 (0.88)	0.63 (0.75)	0.72 (0.83)	<0.001
0	763 (45.0)	364 (42.3)	835 (52.2)	1962 (47.2)	<0.001
1	654 (38.6)	363 (42.2)	575 (35.9)	1592 (38.3)	
2+	278 (16.4)	133 (15.5)	191 (11.9)	602 (14.5)	
Number of FP Visits Mean (SD)	12.44 (10.23)	13.46 (9.92)	11.41 (10.17)	12.33 (10.16)	<0.001
3-6	907 (53.5)	395 (45.9)	905 (56.5)	2207 (53.1)	<0.001
7-10	416 (24.5)	215 (25.0)	383 (23.9)	1014 (24.4)	
11+	372 (21.9)	250 (29.1)	313 (19.6)	935 (22.5)	

Table M18: Co-variates by Continuity of Care Level, Continuity (1999-2000) and Outcomes (2001-2002); Ages 20-44 (N=17,318)

Characteristic	Low Continuity COC < 0.5	Medium Continuity 0.5≤COC<0.75	High Continuity COC ≥ 0.75	Total	p-value
		[Count (%)]			
n (% of Sample)	5038 (29.1)	3735 (21.6)	8545 (49.3)	17,318 (100)	--
Gender					
Male	1837 (36.5)	1221 (32.7)	3336 (39.0)	6394 (36.9)	<0.001
Female	3199 (63.5)	2515 (67.3)	5210 (61.0)	10,924 (63.1)	
Age (years)					
Mean (SD)	32.41 (7.22)	33.56 (6.89)	34.61 (6.82)	33.75 (7.02)	<0.001
Income Quintile					
1 (Low)	593 (12.5)	488 (13.8)	1199 (14.8)	2280 (13.9)	<0.001
2	707 (14.8)	570 (16.1)	1403 (17.4)	2680 (16.4)	
3	966 (20.3)	705 (19.9)	1720 (21.3)	3391 (20.7)	
4	1260 (26.5)	917 (25.9)	1931 (23.9)	4108 (25.1)	
5 (High)	1237 (26.0)	857 (24.2)	1823 (22.6)	3917 (23.9)	
Rural/Urban					
Urban	1904 (38.2)	1494 (40.3)	3505 (41.4)	6903 (40.2)	0.001
Rural	3085 (61.8)	2214 (59.7)	4971 (58.6)	10,270 (59.3)	
Number of Chronic Conditions					
Mean (SD)	1.05 (1.01)	1.19 (1.09)	1.08 (1.05)	1.09 (1.05)	<0.001
0	1710 (34.0)	1108 (29.7)	2846 (33.3)	5664 (32.7)	<0.001
1	1947 (38.7)	1416 (37.9)	3307 (38.7)	6670 (38.5)	
2+	1379 (27.4)	1212 (32.4)	2393 (28.0)	4984 (28.8)	
Number of FP Visits					
Mean (SD)	16.08 (15.61)	17.78 (15.79)	16.53 (16.45)	16.66 (16.05)	<0.001
3-6	2202 (43.7)	1278 (34.2)	3589 (42.0)	7069 (40.8)	<0.001
7-10	1243 (24.7)	879 (23.5)	1989 (23.3)	4111(23.7)	
11+	1591 (31.6)	1579 (42.3)	2968 (34.7)	6138 (35.4)	

Table M19: Co-variates by Continuity of Care Level, Continuity (1999-2000) and Outcomes (2001-2002); Ages 45-64 (N=13,762)

Characteristic	Low Continuity COC < 0.5	Medium Continuity 0.5≤COC<0.75	High Continuity COC ≥ 0.75	Total	p-value
		[Count (%)]			
n (% of Sample)	2549 (18.5)	2493 (18.1)	8720 (63.3)	13,762 (100)	--
Gender					
Male	1023 (40.1)	1060 (42.5)	4177 (47.9)	6260 (45.5)	<0.001
Female	1526 (59.9)	1434 (57.5)	4543 (52.1)	7503 (54.5)	
Age (years)					
Mean (SD)	53.10 (5.55)	53.41 (5.53)	53.99 (5.58)	53.73 (5.58)	<0.001
Income Quintile					
1 (Low)	382 (16.0)	353 (15.2)	1401 (17.2)	2136 (16.7)	0.001
2	419 (17.6)	445 (19.2)	1590 (19.6)	2454 (19.1)	
3	488 (20.5)	470 (20.3)	1772 (21.8)	2730 (21.3)	
4	596 (25.0)	565 (24.4)	1889 (23.2)	3050 (23.8)	
5 (High)	497 (20.9)	486 (21.0)	1475 (18.1)	2458 (19.2)	
Rural/Urban					
Urban	1226 (48.6)	1164 (47.0)	4264 (49.3)	6654 (48.7)	0.142
Rural	1298 (51.4)	1311 (53.0)	4390 (50.7)	6999 (51.3)	
Number of Chronic Conditions Mean (SD)	1.76 (1.28)	1.92 (1.34)	1.85 (1.29)	1.85 (1.30)	0.016
0	350 (13.7)	295 (11.8)	1113 (12.8)	1758 (12.8)	0.002
1	863 (33.9)	752 (30.2)	2723 (31.2)	4338 (31.5)	
2+	1336 (52.4)	1447 (58.0)	4884 (56.0)	7667 (55.7)	
Number of FP Visits Mean (SD)	19.53 (18.81)	21.68 (17.49)	21.24 (19.85)	20.98 (19.19)	<0.001
3-6	924 (36.2)	654 (26.2)	2719 (31.2)	4297 (31.2)	<0.001
7-10	607 (23.8)	602 (24.1)	2181 (25.0)	3390 (24.6)	
11+	1018 (39.9)	1238 (49.6)	3820 (43.8)	6076 (44.1)	

Table M20: Co-variates by Continuity of Care Level, Continuity (1999-2000) and Outcomes (2001-2002); Ages 65-74 (N=4176)

Characteristic	Low Continuity COC < 0.5	Medium Continuity 0.5≤COC<0.75	High Continuity COC ≥ 0.75	Total	p-value
	[Count (%)]				
n (% of Sample)	618 (14.7)	707 (16.9)	2851 (68.3)	4176 (100)	--
Gender					
Male	278 (45.0)	312 (44.3)	1382 (48.5)	1972 (47.3)	0.062
Female	340 (55.0)	393 (55.7)	1468 (51.5)	2201 (52.7)	
Age (years)					
Mean (SD)	69.67 (2.87)	69.64 (2.91)	69.73 (2.85)	69.71 (2.86)	0.310
Income Quintile					
1 (Low)	109 (19.2)	105 (16.2)	475 (17.9)	689 (17.8)	0.043
2	112 (19.7)	116 (17.9)	567 (21.3)	795 (20.5)	
3	118 (20.7)	151 (23.3)	590 (22.2)	859 (22.2)	
4	146 (25.7)	143 (22.0)	565 (21.3)	854 (22.0)	
5 (High)	84 (14.8)	134 (20.6)	460 (17.3)	678 (17.5)	
Rural/Urban					
Urban	333 (54.2)	334 (47.9)	1382 (49.0)	2049 (49.6)	0.037
Rural	281 (45.8)	364 (52.1)	1440 (51.0)	2085 (50.4)	
Number of Chronic Conditions (Mean (SD))	2.59 (1.61)	2.71 (1.59)	2.56 (1.50)	2.59 (1.53)	
0	33 (5.3)	30 (4.3)	121 (4.2)	184 (4.4)	0.548
1	122 (19.7)	131 (18.6)	589 (20.7)	842 (20.2)	
2+	463 (74.9)	544 (77.2)	2140 (75.1)	3147 (75.4)	
Number of FP Visits					
Mean (SD)	24.26 (18.40)	26.53 (20.83)	26.04 (21.37)	25.82 (20.79)	0.019
3-6	157 (25.4)	131 (18.6)	553 (19.4)	841 (20.2)	0.003
7-10	148 (23.9)	162 (23.0)	643 (22.6)	953 (22.8)	
11+	313 (50.6)	412 (58.4)	1654 (58.0)	2379 (57.0)	

Appendix N: Regression Analyses by Age Group

13.The following abbreviations are used for Phase I (CCHS Sample) regression output:

age	Age (continuous variable)
gender	Female gender (Reference: Male)
marstat	Marital Status: unpartnered (reference: partnered)
phys_act	Physical activity: inactive (reference: active)
rural_urb	Urban place of residence (reference: rural)
vstgrp1	Number of FP visits: low (reference: high)
vstgrp2	Number of FP visits: medium (reference: high)
cc_med	1 chronic condition (reference: 0 chronic conditions)
cc_high	2+ chronic conditions (reference: 0 chronic conditions)
coc_l	Continuity of care: low (reference: high)
coc_m	Continuity of care: medium (reference: high)
income_ade	Income adequacy: Lower two income quartiles (Reference: upper: two income quartiles)

The following abbreviations are used for Phase I (MCP) regression output

age	Age (continuous variable)
gender	Female gender (Reference: Male)
chron_med	1 chronic condition (reference: 0 chronic conditions)
chron_high	2+ chronic conditions (reference: 0 chronic conditions)
income_2	Second income quintile (Reference: First income quintile [i.e lowest income quintile])
income_3	Third income quintile (Reference: First income quintile)
income_4	Fourth income quintile (Reference: First income quintile)
income_5	Fifth income quintile (Highest income quintile) (Reference: First income quintile)
urban	Urban place of residence (reference: rural)
tot_vsts_low	Number of FP visits: low (reference: high)
tot_vsts_med	Number of FP visits: medium (reference: high)
coc_low	Continuity of care: low (reference: high)
coc_med	Continuity of care: medium (reference: high)
Exp(β)	Exponentiated beta co-efficient

1) Health Services Utilization

Two types of regression models were used to model health care service utilization outcomes. Poisson regression was used to model number of hospitalizations and number of hospitalizations for ACSCs. Negative Binomial Regression was used to model number of specialist visits and number of ambulatory specialist visits.

For all models the residual deviance was significantly less than the null deviance indicating better fit than the null model.

Rate ratios and their 95% confidence intervals for all models are presented below.

Note that in the Phase I (CCHS) analysis neither smoking, drinking, nor fruit and vegetable consumption was a significant predictor of heath care services utilization in any model and, therefore, these variables do not appear in the output below.

A) Phase I: (CCHS Sample)

Age 12+

Hospitalizations

Variable	Rate Ratio	95% Confidence Interval	
age	1.0099900	1.0060231	1.0139727
gender	1.0121994	0.8790802	1.1654767
marstat	1.0957323	0.9504829	1.2631782
phys_act	1.5045318	1.2858059	1.7604646
rural_urb	0.6732409	0.5878295	0.7710626
vstgrp1	0.3498506	0.2883276	0.4245015
vstgrp2	0.5082693	0.4286450	0.6026843
cc_med	0.8942615	0.7235218	1.1052930
cc_high	1.4075184	1.1658214	1.6993238
coc_l	1.2502440	1.0540497	1.4829568
coc_m	1.5527675	1.3243119	1.8206337
income_ade	0.8337993	0.7221806	0.9626695

Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
gender	1.1614455	1.0572500	1.2759098
age	1.0171696	1.0144385	1.0199081
phys_act	1.0697251	0.9741450	1.1746832
rural_urb	0.9638773	0.8758816	1.0607135
vstgrp1	0.3813945	0.3391792	0.4288640
vstgrp2	0.6468957	0.5770672	0.7251738
cc_med	0.9473330	0.8436597	1.0637463
cc_high	1.4669837	1.3064798	1.6472058
coc_l	1.1149811	0.9997615	1.2434793
coc_m	1.2256676	1.0926269	1.3749076
income_ade	1.0670933	0.9740292	1.1690494

Ambulatory Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
gender	1.1419761	0.9882932	1.3195571
phys_act	1.1022014	0.9548506	1.2722911
age	1.0147749	1.0106209	1.0189459
vstgrp1	0.3313873	0.2769699	0.3964963
vstgrp2	0.6988515	0.5871437	0.8318124
rural_urb	1.1784289	1.0170409	1.3654265
cc_med	1.0328377	0.8633493	1.2355992
cc_high	1.5398176	1.2896754	1.8384767
coc_l	1.1875551	1.0046757	1.4037238
coc_m	1.2849714	1.0754492	1.5353134
income_ade	1.3523510	1.1766536	1.5542834

Age 55+

Hospitalizations

Variable	Rate Ratio	95% Confidence Interval	
age	1.03811438	1.02607188	1.05029822
gender	0.69222246	0.55725233	0.85988324
marstat	1.30101233	1.03363056	1.63756099
phys_act	1.82611505	1.38179778	2.41330261
rural_urb	0.65745508	0.53500793	0.80792669
vstgrp1	0.63996682	0.47877572	0.85542670
vstgrp2	0.75488828	0.58465091	0.97469500
cc_med	1.05690555	0.66787951	1.67253122
cc_high	2.11677302	1.42451236	3.14544694
coc_l	1.60755205	1.22194537	2.11484381
coc_m	1.50346934	1.17222002	1.92832404
income_ade	0.65707472	0.50575593	0.85366709

Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
gender	1.0568292	0.8979283	1.2438498
age	1.0156115	1.0066219	1.0246814
phys_act	1.1521221	0.9750177	1.3613963
rural_urb	1.0658241	0.9124954	1.2449170
vstgrp1	0.5347393	0.4388241	0.6516190
vstgrp2	0.7609415	0.6394353	0.9055365
cc_med	0.9579988	0.7531545	1.2185570
cc_high	1.6747237	1.3495507	2.0782468
coc_l	1.3678782	1.1054080	1.6926698
coc_m	1.2754091	1.0515877	1.5468690
income_ade	0.9440644	0.7996822	1.1145149

Ambulatory Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
gender	0.9356204	0.7501416	1.1669603
phys_act	1.3032695	1.0443022	1.6264557
age	1.0082214	0.9959737	1.0206196
vstgrp1	0.5944144	0.4541578	0.7779863
vstgrp2	0.8115347	0.6445462	1.0217865
rural_urb	1.4062953	1.1417914	1.7320734
cc_med	1.0588069	0.7605644	1.4740000
cc_high	1.9386084	1.4421602	2.6059536
coc_l	1.5100172	1.1358968	2.0073584
coc_m	1.3877212	1.0748086	1.7917330
income_ade	1.0721950	0.8583221	1.3393599

Age 65+

Hospitalizations

Variable	Rate Ratio	95% Confidence Interval	
age	1.03471644	1.01559916	1.0541936
gender	0.58753434	0.45249260	0.7628779
marstat	1.32856070	1.01383945	1.7409793
phys_act	1.75274146	1.26063965	2.4369395
rural_urb	0.69370444	0.54224055	0.8874767
vstgrp1	0.79380728	0.57223957	1.1011647
vstgrp2	0.82658929	0.60878400	1.1223190
cc_med	0.81980719	0.47016634	1.4294597
cc_high	1.86263765	1.17211252	2.9599709
coc_l	1.76252215	1.27743947	2.4318055
coc_m	1.87292519	1.40847024	2.4905381
income_ade	0.83296248	0.60759887	1.1419154

Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
gender	0.9872216	0.7923386	1.2300380
age	1.0106948	0.9944316	1.0272239
phys_act	1.0621895	0.8381862	1.3460573
rural_urb	1.2302479	0.9930955	1.5240325
vstgrp1	0.6388663	0.4861536	0.8395497
vstgrp2	0.8088658	0.6349779	1.0303725
cc_med	0.8305046	0.5741020	1.2014207
cc_high	1.6044780	1.1722051	2.1961599
coc_l	1.6521206	1.2180622	2.2408563
coc_m	1.4556999	1.1164302	1.8980695
income_ade	0.9304928	0.7238297	1.1961610

Ambulatory Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
gender	0.9327798	0.7172307	1.213108
phys_act	1.1779117	0.8927717	1.554122
age	1.0077735	0.9881396	1.027797
vstgrp1	0.6776169	0.4897736	0.937504
vstgrp2	0.7975083	0.5988473	1.062073
rural_urb	1.7303779	1.3435287	2.228615
cc_med	0.8883294	0.5669839	1.391802
cc_high	1.5950167	1.0874084	2.339579
coc_l	1.8714687	1.3031081	2.687724
coc_m	1.2655212	0.9302912	1.721551
income_ade	0.9638273	0.7183723	1.293150

B) Phase II (MCP Sample) Cross-sectional Analysis (Continuity of Care and Outcomes 1999-2002)

i) First set of Age Groups

Ages 12+

Hospitalizations

Variable	Rate Ratio	95% Confidence Interval	
age	1.0152418	1.0144854	1.0159989
gender	1.0385559	1.0122115	1.0655860
chron_med	1.0116569	0.9675914	1.0577293
chron_high	1.7982528	1.7214377	1.8784955
income_2	1.3856981	1.3204317	1.4541906
income_3	1.2996742	1.2404805	1.3616926
income_4	1.1923240	1.1425806	1.2442332
income_5	1.1219326	1.0765454	1.1692333
urban	0.9263187	0.8987011	0.9547850
tot_vsts_low	0.5283729	0.5091866	0.5482821
tot_vsts_med	0.6600174	0.6399800	0.6806821
coc_low	1.0256579	0.9943342	1.0579684
coc_med	1.0502475	1.0175105	1.0840377

14.
15.Hospitalizations for ACSCs

Variable	Rate Ratio	95% Confidence Interval	
age	1.063324399	1.060684797	1.065970571
gender	0.680896790	0.629156609	0.736891947
income_2	2.108281926	1.797837672	2.472332597
income_3	1.807492118	1.545892747	2.113359910
income_4	1.344873348	1.156394990	1.564071393
income_5	1.243430229	1.071462816	1.442998030
urban	0.826198447	0.750762388	0.909214266
tot_vsts_low	0.400920077	0.358890584	0.447871623
tot_vsts_med	0.472495574	0.426420451	0.523549156
coc_low	1.016500116	0.916353806	1.127591197
coc_med	1.132266852	1.025732708	1.249865793

Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	1.0134131	1.0128079	1.0140188
gender	1.0660733	1.0448238	1.0877550
chron_med	1.2537060	1.2212893	1.2869832
chron_high	1.8266384	1.7736909	1.8811664
income_2	1.0291999	0.9913267	1.0685201
income_3	0.9954255	0.9606097	1.0315031
income_4	1.0126957	0.9815893	1.0447878
income_5	0.9726381	0.9445664	1.0015441
urban	1.2032211	1.1744189	1.2327297
tot_vsts_low	0.4703763	0.4579150	0.4831768
tot_vsts_med	0.6819439	0.6650420	0.6992753
coc_low	0.9735691	0.9510077	0.9966658
coc_med	1.0276431	1.0020541	1.0538855

16.Ambulatory Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	1.0067567	1.0060116	1.0075024
gender	1.0605762	1.0343648	1.0874518
chron_med	1.1957217	1.1570163	1.2357218
chron_high	1.6350724	1.5762793	1.6960584
income_2	0.9198004	0.8780194	0.9635695
income_3	0.8400543	0.8037591	0.8779885
income_4	0.9120607	0.8776784	0.9477899
income_5	0.9048393	0.8728336	0.9380185
urban	1.4684789	1.4248367	1.5134578
tot_vsts_low	0.4105229	0.3970658	0.4244360
tot_vsts_med	0.6531577	0.6333638	0.6735702
coc_low	1.0076856	0.9787372	1.0374902
coc_med	1.0411044	1.0090751	1.0741504

Ages 55+

Hospitalizations

Variable	Rate Ratio	95% Confidence Interval	
age	1.03103562	1.02913713	1.03293761
gender	0.77846476	0.75135029	0.80655773
chron_med	1.08611162	0.97115579	1.21467478
chron_high	2.65290918	2.39331426	2.94066151
income_2	1.31191819	1.22405974	1.40608280
income_3	1.26316449	1.18153130	1.35043779
income_4	1.08449147	1.01824382	1.15504923
income_5	1.11085152	1.04471930	1.18117002
urban	0.88291539	0.84583704	0.92161912
tot_vsts_low	0.88427263	0.84069331	0.93011099
tot_vsts_med	0.76303283	0.73033777	0.79719156
coc_low	1.04852777	1.00095777	1.09835850
coc_med	1.08241658	1.03470969	1.13232307

Hospitalizations for ACSCs

Variable	Rate Ratio	95% Confidence Interval	
age	1.053266436	1.048568868	1.057985049
gender	0.723047353	0.661736943	0.790038218
income_2	1.990882213	1.668141439	2.376064698
income_3	1.730615657	1.455411762	2.057857872
income_4	1.287243602	1.088537770	1.522221954
income_5	1.086904579	0.917918028	1.287001157
urban	0.833760736	0.748811394	0.928347205
tot_vsts_low	0.480180550	0.423804172	0.544056374
tot_vsts_med	0.494328576	0.440210211	0.555100120
coc_low	1.087625542	0.967490402	1.222678094
coc_med	1.190187506	1.065746263	1.329159057

Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	0.9999080	0.9979947	1.0018250
gender	0.8773927	0.8468823	0.9090024
chron_med	1.0995891	1.0214151	1.1837462
chron_high	1.8821590	1.7526266	2.0212649
income_2	0.9499093	0.8879155	1.0162315
income_3	0.9649420	0.9046078	1.0293004
income_4	0.9744083	0.9191390	1.0330009
income_5	1.0006896	0.9457311	1.0588418
urban	1.2687757	1.2154825	1.3244056
tot_vsts_low	0.6189959	0.5893507	0.6501323
tot_vsts_med	0.7361241	0.7057904	0.7677615
coc_low	1.0587172	1.0105214	1.1092117
coc_med	1.0770935	1.0289027	1.1275414

Ambulatory Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	1.0096110	1.0082688	1.0109549
gender	1.1648426	1.1287788	1.2020586
chron_med	1.1888148	1.1459005	1.2333361
chron_high	1.5724563	1.5064509	1.6413537
income_2	0.9449315	0.8920275	1.0009731
income_3	0.8640301	0.8181683	0.9124626
income_4	0.9254548	0.8831598	0.9697754
income_5	0.8943787	0.8564271	0.9340120
urban	1.4394552	1.3864160	1.4945235
tot_vsts_low	0.3910160	0.3751603	0.4075419
tot_vsts_med	0.6358203	0.6113276	0.6612943
coc_low	0.9967892	0.9624699	1.0323322
coc_med	1.0467367	1.0072108	1.0878137

Ages 65+

Hospitalizations

Variable	Rate Ratio	95% Confidence Interval	
age	1.02346535	1.02039714	1.0265428
gender	0.78847147	0.75586432	0.8224853
chron_med	1.13806733	0.97781987	1.3245765
chron_high	2.84480954	2.47405969	3.2711181
income_2	1.33310406	1.22793108	1.4472852
income_3	1.29898973	1.20051530	1.4055417
income_4	1.10535123	1.02621903	1.1905854
income_5	1.07990413	1.00347526	1.1621541
urban	0.89602209	0.85150565	0.9428659
tot_vsts_low	0.95674732	0.90135050	1.0155488
tot_vsts_med	0.81382072	0.77237338	0.8574922
coc_low	1.07380011	1.01690341	1.1338802
coc_med	1.07721181	1.02035990	1.1372314

Hospitalizations for ACSCs

Variable	Rate Ratio	95% Confidence Interval	
age	1.0317893	1.02471354	1.03891399
gender	0.7369525	0.66728976	0.81388769
income_2	1.8704143	1.53470805	2.27955374
income_3	1.7396393	1.43585310	2.10769811
income_4	1.2667056	1.05148925	1.52597189
income_5	0.9837702	0.81231409	1.19141581
urban	0.8022362	0.71089749	0.90531051
tot_vsts_low	0.5156029	0.44795281	0.59346958
tot_vsts_med	0.5028463	0.44080449	0.57362039
coc_low	1.1546408	1.01475832	1.31380584
coc_med	1.2533487	1.10766693	1.41819076

Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	0.9839788	0.9805923	0.9873771
gender	0.8348109	0.7961322	0.8753687
chron_med	1.1369318	1.0154739	1.2729170
chron_high	1.9607583	1.7612078	2.1829185
income_2	0.9688941	0.8855922	1.0600316
income_3	1.0041370	0.9217361	1.0939044
income_4	0.9848006	0.9115173	1.0639756
income_5	0.9821925	0.9108634	1.0591073
urban	1.3475761	1.2727240	1.4268303
tot_vsts_low	0.6771416	0.6339276	0.7233014
tot_vsts_med	0.7832305	0.7403657	0.8285770
coc_low	1.1029815	1.0368778	1.1732995
coc_med	1.0686751	1.0050534	1.1363242

17.Ambulatory Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	1.0099995	1.0089305	1.0110696
gender	1.1211722	1.0899782	1.1532589
chron_med	1.1811099	1.1408249	1.2228174
chron_high	1.5990124	1.5370738	1.6634468
income_2	0.9255556	0.8786623	0.9749515
income_3	0.8435712	0.8029308	0.8862687
income_4	0.9083235	0.8703700	0.9479321
income_5	0.8987722	0.8637707	0.9351920
urban	1.4403433	1.3924189	1.4899171
tot_vsts_low	0.3966758	0.3821472	0.4117568
tot_vsts_med	0.6375794	0.6157136	0.6602216
coc_low	0.9997442	0.9680619	1.0324635
coc_med	1.0442880	1.0085513	1.0812910

Ages 75+

Hospitalizations

Variable	Rate Ratio	95% Confidence Interval	
age	1.0053480	0.9990008	1.0117356
gender	0.7777701	0.7326106	0.8257132
chron_med	1.1675838	0.9385026	1.4525818
chron_high	2.8083664	2.2985138	3.4313137
income_2	1.4136825	1.2602821	1.5857548
income_3	1.3546347	1.2138335	1.5117684
income_4	1.1698012	1.0547981	1.2973430
income_5	1.0898662	0.9823261	1.2091793
urban	0.8638967	0.8041646	0.9280656
tot_vsts_low	0.9225670	0.8488828	1.0026471
tot_vsts_med	0.8505343	0.7903343	0.9153198
coc_low	1.1934790	1.1085240	1.2849447
coc_med	1.1174985	1.0365051	1.2048208

18.Hospitalizations for ACSCs

Variable	Rate Ratio	95% Confidence Interval	
age	0.9998365	0.9854793	1.0144029
gender	0.6803107	0.5933648	0.7799967
income_2	2.1341011	1.6256148	2.8016399
income_3	2.0993649	1.6174505	2.7248641
income_4	1.4761951	1.1447118	1.9036686
income_5	1.0018590	0.7641505	1.3135128
urban	0.8357544	0.7087500	0.9855173
tot_vsts_low	0.6071273	0.5046705	0.7303847
tot_vsts_med	0.5579891	0.4661173	0.6679688
coc_low	1.4002894	1.1808650	1.6604865
coc_med	1.5022037	1.2743868	1.7707465

Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	0.9557350	0.9486319	0.9628913
gender	0.7676330	0.7141013	0.8251775
chron_med	1.3986240	1.1773944	1.6614222
chron_high	2.2759319	1.9361929	2.6752841
income_2	0.8926990	0.7814374	1.0198021
income_3	0.9478864	0.8362913	1.0743727
income_4	0.9273284	0.8279114	1.0386836
income_5	0.9739460	0.8716397	1.0882602
urban	1.3482188	1.2379148	1.4683514
tot_vsts_low	0.7447174	0.6760469	0.8203631
tot_vsts_med	0.8066830	0.7408957	0.8783119
coc_low	1.1746781	1.0734281	1.2854783
coc_med	1.0673837	0.9750983	1.1684030

19.Ambulatory Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	1.0095661	1.0086799	1.0104530
gender	1.0906624	1.0625115	1.1195591
chron_med	1.1770741	1.1382910	1.2171785
chron_high	1.5972336	1.5381730	1.6585620
income_2	0.9205855	0.8770370	0.9662963
income_3	0.8371032	0.7994033	0.8765810
income_4	0.9084779	0.8728708	0.9455375
income_5	0.9010128	0.8679695	0.9353141
urban	1.4567875	1.4116407	1.5033781
tot_vsts_low	0.4041003	0.3902886	0.4184008
tot_vsts_med	0.6449279	0.6244877	0.6660372
coc_low	1.0062976	0.9762526	1.0372673
coc_med	1.0463698	1.0128547	1.0809940

ii) Second set of age groups
20.
21.Age 12-19

Hospitalizations

Variable	Rate Ratio	95% Confidence Interval	
age	1.0683017	1.0439428	1.0932289
gender	1.2696386	1.1208908	1.4381259
chron_med	1.4400742	1.2722823	1.6299949
chron_high	1.8431987	1.5862748	2.1417358
income_2	1.9351997	1.5871647	2.3595521
income_3	1.8850337	1.5552593	2.2847328
income_4	1.3323262	1.1109313	1.5978423
income_5	1.2494313	1.0536008	1.4816602
urban	0.8601213	0.7600495	0.9733689
tot_vsts_low	0.3302835	0.2850845	0.3826486
tot_vsts_med	0.5096068	0.4458758	0.5824472
coc_low	0.8445737	0.7484029	0.9531024
coc_med	0.8694545	0.7531337	1.0037410

Hospitalizations for ACSCs

Variable	Rate Ratio	95% Confidence Interval	
age	1.0553135	0.9295068	1.1981480
gender	0.7138530	0.3780753	1.3478429
income_2	1.0154617	0.3677633	2.8038752
income_3	0.5680705	0.1816129	1.7768785
income_4	0.7412074	0.3034660	1.8103787
income_5	0.6844225	0.3020229	1.5509892
urban	0.9039345	0.4315720	1.8933051
tot_vsts_low	0.3303774	0.1549584	0.7043775
tot_vsts_med	0.4769681	0.2201159	1.0335400
coc_low	0.8782329	0.4541485	1.6983278
coc_med	0.7743774	0.3400737	1.7633248

Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	0.9908552	0.9763790	1.0055461
gender	0.8555677	0.7959751	0.9196218
chron_med	1.5917845	1.4769827	1.7155096
chron_high	2.0238951	1.8094485	2.2637569
income_2	1.0429588	0.9163275	1.1870898
income_3	1.0313994	0.9109057	1.1678318
income_4	0.9547544	0.8586576	1.0616059
income_5	0.9896859	0.9000113	1.0882953
urban	1.0913026	1.0027257	1.1877041
tot_vsts_low	0.3853336	0.3462129	0.4288747
tot_vsts_med	0.5786840	0.5198811	0.6441380
coc_low	0.8862756	0.8196133	0.9583598
coc_med	0.9849790	0.8967586	1.0818782

Ambulatory Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	0.9889546	0.9708555	1.0073912
gender	0.8354160	0.7628674	0.9148640
chron_med	1.4758527	1.3436526	1.6210598
chron_high	1.7993946	1.5670230	2.0662242
income_2	0.9478728	0.8056878	1.1151502
income_3	0.9401379	0.8044952	1.0986507
income_4	0.8999464	0.7884155	1.0272549
income_5	0.9291791	0.8255767	1.0457827
urban	1.3417556	1.2056978	1.4931668
tot_vsts_low	0.3262367	0.2858874	0.3722807
tot_vsts_med	0.5586162	0.4899766	0.6368714
coc_low	0.9024563	0.8179919	0.9996423
coc_med	1.0163005	0.9037709	1.1428412

Age 20-44

Hospitalizations

Variable	Rate Ratio	95% Confidence Interval	
age	0.9723390	0.9691579	0.9755305
gender	1.5682649	1.4852252	1.6559473
chron_med	1.0612545	1.0003459	1.1258716
chron_high	1.4833468	1.3944973	1.5778572
income_2	1.3865815	1.2717805	1.5117454
income_3	1.2355437	1.1364472	1.3432813
income_4	1.2616281	1.1738302	1.3559930
income_5	1.1200190	1.0448223	1.2006277
urban	0.9701997	0.9176836	1.0257211
tot_vsts_low	0.3585163	0.3357308	0.3828483
tot_vsts_med	0.6016789	0.5697476	0.6353997
coc_low	0.8496663	0.8051998	0.8965885
coc_med	0.9905725	0.9363638	1.0479194

Hospitalizations for ACSCs

Variable	Rate Ratio	95% Confidence Interval	
age	1.0238537	1.0014052	1.0468055
gender	0.4922750	0.3617752	0.6698490
income_2	3.3621163	1.7833911	6.3383886
income_3	3.2571555	1.7577284	6.0356663
income_4	1.6267514	0.8714973	3.0365215
income_5	2.6947487	1.5480206	4.6909392
urban	0.8748850	0.6153396	1.2439047
tot_vsts_low	0.3254825	0.2232626	0.4745034
tot_vsts_med	0.6409097	0.4508167	0.9111580
coc_low	0.6784084	0.4651021	0.9895418
coc_med	1.0281561	0.7193204	1.4695885

Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	1.0157402	1.0134851	1.0180004
gender	1.2412869	1.2013867	1.2825123
chron_med	1.2308550	1.1871465	1.2761729
chron_high	1.7156120	1.6431297	1.7912916
income_2	1.0833431	1.0209949	1.1494986
income_3	1.0133278	0.9583532	1.0714560
income_4	1.0432088	0.9944334	1.0943765
income_5	0.9768309	0.9343836	1.0212065
urban	1.1674258	1.1232603	1.2133278
tot_vsts_low	0.4135482	0.3964258	0.4314102
tot_vsts_med	0.6551279	0.6288263	0.6825296
coc_low	0.9579295	0.9245725	0.9994898
coc_med	1.0200280	0.9806312	1.0610075

Ambulatory Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	1.0101214	1.0072298	1.0130214
gender	1.2899401	1.2365845	1.3455980
chron_med	1.1471473	1.0946199	1.2021954
chron_high	1.5573642	1.4734596	1.6460467
income_2	0.9907085	0.9178889	1.0693052
income_3	0.8567629	0.7972455	0.9207234
income_4	0.9341011	0.8785505	0.9931640
income_5	0.9178323	0.8671928	0.9714289
urban	1.4369452	1.3669504	1.5105240
tot_vsts_low	0.3881214	0.3676274	0.4097580
tot_vsts_med	0.6517944	0.6187228	0.6866338
coc_low	1.0029423	0.9581100	1.0498723
coc_med	1.0631220	1.0105930	1.1183814

Age 45-64

Hospitalizations

Variable	Rate Ratio	95% Confidence Interval	
age	1.03571987	1.03140564	1.04005215
gender	0.81231587	0.77475016	0.85170304
chron_med	1.01016542	0.91182721	1.11910914
chron_high	2.11222209	1.91736668	2.32688000
income_2	1.29501181	1.18022595	1.42096146
income_3	1.22709404	1.12142971	1.34271436
income_4	1.13376787	1.04335285	1.23201809
income_5	1.15597326	1.06732258	1.25198716
urban	0.89783410	0.84802465	0.95056915
tot_vsts_low	0.63041189	0.58828928	0.67555055
tot_vsts_med	0.61727586	0.58263610	0.65397508
coc_low	1.00225239	0.94261247	1.06566577
coc_med	1.01802738	0.95937680	1.08026350

Hospitalizations for ACSCs

Variable	Rate Ratio	95% Confidence Interval	
age	1.07369568	1.05923262	1.08835622
gender	0.67586078	0.57990636	0.78769233
income_2	2.29787894	1.67090787	3.16010697
income_3	1.62273412	1.17426941	2.24247180
income_4	1.44989554	1.06802222	1.96830836
income_5	1.65784932	1.23920246	2.21793005
urban	0.80087693	0.66695833	0.96168505
tot_vsts_low	0.30355880	0.24421787	0.37731859
tot_vsts_med	0.38363490	0.31593449	0.46584256
coc_low	0.87642152	0.71054285	1.08102513
coc_med	0.98822830	0.81620858	1.19650197

Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	1.0207292	1.0177103	1.0237570
gender	1.0660684	1.0314034	1.1018986
chron_med	1.1036159	1.0479827	1.1622025
chron_high	1.6623359	1.5765916	1.7527435
income_2	0.9728183	0.9134173	1.0360823
income_3	0.9388683	0.8840077	0.9971335
income_4	0.9812946	0.9300668	1.0353439
income_5	0.9516409	0.9043176	1.0014406
urban	1.2270437	1.1787045	1.2773654
tot_vsts_low	0.5094850	0.4869782	0.5330320
tot_vsts_med	0.6661367	0.6400679	0.6932672
coc_low	1.0295698	0.9875005	1.0734314
coc_med	1.0317626	0.9897552	1.0755529

Ambulatory Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	1.0163130	1.0125549	1.0200850
gender	1.0145037	0.9733480	1.0573995
chron_med	1.0961096	1.0261027	1.1708928
chron_high	1.5550879	1.4541177	1.6630692
income_2	0.8393608	0.7757787	0.9081540
income_3	0.7986648	0.7408113	0.8610363
income_4	0.8592506	0.8039201	0.9183894
income_5	0.8660715	0.8130267	0.9225771
urban	1.4748330	1.4023370	1.5510769
tot_vsts_low	0.4362467	0.4121387	0.4617649
tot_vsts_med	0.6322324	0.6016618	0.6643562
coc_low	1.0702933	1.0158120	1.1276965
coc_med	1.0339323	0.9815468	1.0891136

Age 65-74

Hospitalizations

Variable	Rate Ratio	95% Confidence Interval	
age	1.03860607	1.02786423	1.04946018
gender	0.81142134	0.76442987	0.86130151
chron_med	1.08450174	0.87790161	1.33972192
chron_high	2.76180906	2.27131709	3.35822299
income_2	1.23386253	1.09682233	1.38802494
income_3	1.24334229	1.11016603	1.39249447
income_4	1.03739637	0.93236163	1.15426376
income_5	1.06864291	0.96315493	1.18568429
urban	0.91937885	0.85483610	0.98879477
tot_vsts_low	1.00197492	0.91956383	1.09177168
tot_vsts_med	0.77825630	0.72231105	0.83853468
coc_low	0.95764423	0.88297867	1.03862357
coc_med	1.04308586	0.96441793	1.12817076

Hospitalizations for ACSCs

Variable	Rate Ratio	95% Confidence Interval	
age	1.08133538	1.05448639	1.10886798
gender	0.83492873	0.72314701	0.96398930
income_2	1.53895546	1.15366786	2.05291659
income_3	1.36013946	1.02472874	1.80533566
income_4	1.03582476	0.78773078	1.36205535
income_5	0.95531920	0.72804529	1.25354122
urban	0.74406108	0.62250914	0.88934740
tot_vsts_low	0.43326327	0.34783987	0.53966517
tot_vsts_med	0.44687998	0.36807556	0.54255630
coc_low	0.92054927	0.75279538	1.12568566
coc_med	1.01770006	0.84176033	1.23041367

Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	1.0107673	0.9998503	1.0218036
gender	0.9090238	0.8541875	0.9673805
chron_med	0.9514539	0.8200834	1.1038688
chron_high	1.6695887	1.4475259	1.9257178
income_2	1.0267050	0.9102327	1.1580811
income_3	1.0597288	0.9440096	1.1896331
income_4	1.0376484	0.9348441	1.1517579
income_5	1.0003121	0.9038205	1.1071052
urban	1.3380194	1.2400402	1.4437402
tot_vsts_low	0.6392227	0.5847548	0.6987642
tot_vsts_med	0.7621620	0.7075768	0.8209581
coc_low	1.0519390	0.9673786	1.1438909
coc_med	1.0911688	1.0047712	1.1849956

Ambulatory Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	1.0024879	0.9906240	1.0144939
gender	0.8493252	0.7933229	0.9092808
chron_med	0.9764496	0.8263937	1.1537527
chron_high	1.4337575	1.2219755	1.6822437
income_2	0.8598952	0.7539894	0.9806765
income_3	0.7915583	0.6977048	0.8980368
income_4	0.9159393	0.8180755	1.0255101
income_5	0.9219559	0.8261958	1.0288151
urban	1.6202984	1.4907389	1.7611179
tot_vsts_low	0.5117203	0.4634101	0.5650669
tot_vsts_med	0.6989344	0.6443546	0.7581373
coc_low	1.0853238	0.9900651	1.1897477
coc_med	1.0560352	0.9648910	1.1557889

C) Phase II (MCP Sample) Longitudinal Analysis
(Continuity of Care 1999-2000 and Outcomes 2001-2002)

i) First Set of Age Groups

Ages 12+

Hospitalizations

Variable	Rate Ratio	95% Confidence Interval	
age	1.01449711	1.01335116	1.0156444
gender	1.03412384	0.99451700	1.0753080
chron_med	1.03760879	0.96457802	1.1161689
chron_high	2.10377752	1.96403565	2.2534621
income_2	1.36612273	1.26926650	1.4703699
income_3	1.30412840	1.21508191	1.3997006
income_4	1.20820575	1.13291078	1.2885049
income_5	1.14123410	1.07225838	1.2146469
urban	0.97638658	0.93252298	1.0223134
tot_vsts_low	0.65903271	0.62554095	0.6943176
tot_vsts_med	0.74548178	0.70924486	0.7835701
coc_low	1.00075771	0.95262306	1.0513245
coc_med	1.05349114	1.00317574	1.1063302

Hospitalizations for ACSCs

Variable	Rate Ratio	95% Confidence Interval	
age	1.061551971	1.058815411	1.064295604
gender	0.680960762	0.627793743	0.738630425
income_2	1.995253759	1.692921495	2.351578366
income_3	1.713764839	1.458085499	2.014278260
income_4	1.320976740	1.131177735	1.542621899
income_5	1.206056012	1.034429557	1.406157717
urban	0.804381458	0.728622695	0.888017262
tot_vsts_low	0.392828980	0.348054009	0.443363970
tot_vsts_med	0.489783884	0.436123909	0.550046095
coc_low	1.010812325	0.903609853	1.130733086
coc_med	1.102716030	0.992513174	1.225155167

Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	1.0134005	1.0126030	1.0141987
gender	1.1182437	1.0886306	1.1486623
chron_med	1.3409038	1.2927785	1.3908207
chron_high	2.0687500	1.9898687	2.1507582
income_2	0.9448361	0.8987466	0.9932892
income_3	0.9445956	0.9007965	0.9905242
income_4	0.9927266	0.9523734	1.0347896
income_5	0.9717931	0.9346965	1.0103620
urban	1.2197197	1.1810460	1.2596597
tot_vsts_low	0.6348289	0.6143028	0.6560408
tot_vsts_med	0.7721035	0.7463720	0.7987221
coc_low	0.9824691	0.9513901	1.0145633
coc_med	1.0555012	1.0201249	1.0921043

Ambulatory Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	1.0062833	1.0053385	1.0072289
gender	1.0667771	1.0330380	1.1016181
chron_med	1.2519295	1.1974691	1.3088666
chron_high	1.8130742	1.7300593	1.9000724
income_2	0.8665092	0.8162861	0.9198223
income_3	0.7928588	0.7491092	0.8391635
income_4	0.9042929	0.8609938	0.9497694
income_5	0.8836123	0.8439004	0.9251928
urban	1.4810466	1.4248022	1.5395113
tot_vsts_low	0.5676864	0.5457321	0.5905239
tot_vsts_med	0.7263557	0.6976889	0.7562004
coc_low	0.9880180	0.9506283	1.0268783
coc_med	1.0791530	1.0362334	1.1238501

Ages 55+

Hospitalizations

Variable	Rate Ratio	95% Confidence Interval	
age	1.02408318	1.02124571	1.02692853
gender	0.82156263	0.77941532	0.86598908
chron_med	1.21820122	0.98839128	1.50144405
chron_high	3.41279415	2.81157090	4.14258232
income_2	1.31895111	1.19033597	1.46146305
income_3	1.24316606	1.12605682	1.37245459
income_4	1.08833372	0.99200183	1.19402026
income_5	1.12780072	1.03068077	1.23407219
urban	0.92432914	0.86745505	0.98493214
tot_vsts_low	0.73789387	0.68267331	0.79758116
tot_vsts_med	0.76296618	0.71125930	0.81843202
coc_low	0.98225116	0.91144989	1.05855227
coc_med	1.07282417	1.00120952	1.14956127

Hospitalizations for ACSCs

Variable	Rate Ratio	95% Confidence Interval	
age	1.050533378	1.04572628	1.05536257
gender	0.730655199	0.66735045	0.79996503
income_2	1.898274787	1.58286905	2.27652892
income_3	1.651118123	1.38146990	1.97339881
income_4	1.273857781	1.07317189	1.51207244
income_5	1.066458489	0.89670857	1.26834263
urban	0.811357088	0.72662102	0.90597479
tot_vsts_low	0.414600352	0.35967613	0.47791176
tot_vsts_med	0.510528529	0.44830547	0.58138791
coc_low	1.097273222	0.96742145	1.24455429
coc_med	1.184110189	1.05372623	1.33062735

Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	0.9909259	0.9884278	0.9934303
gender	0.9184722	0.8765555	0.9623934
chron_med	1.2512553	1.1240077	1.3929083
chron_high	2.2834364	2.0620547	2.5285856
income_2	0.8888447	0.8129196	0.9718610
income_3	0.8996769	0.8262137	0.9796722
income_4	0.9236125	0.8554162	0.9972457
income_5	0.9859977	0.9154952	1.0619297
urban	1.2664097	1.1967721	1.3400995
tot_vsts_low	0.6735277	0.6332207	0.7164003
tot_vsts_med	0.7558943	0.7127907	0.8016044
coc_low	0.9781009	0.9168713	1.0434196
coc_med	1.0764713	1.0107808	1.1464310

Ambulatory Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	0.9825545	0.9798622	0.9852542
gender	0.8676129	0.8251196	0.9122946
chron_med	1.2527325	1.1107437	1.4128719
chron_high	1.9802299	1.7663969	2.2199487
income_2	0.8226684	0.7475787	0.9053004
income_3	0.8001239	0.7304600	0.8764316
income_4	0.8543465	0.7875824	0.9267702
income_5	0.9281043	0.8581249	1.0037904
urban	1.5661372	1.4735691	1.6645204
tot_vsts_low	0.6287049	0.5877682	0.6724928
tot_vsts_med	0.7244933	0.6800506	0.7718405
coc_low	1.0224500	0.9536354	1.0962303
coc_med	1.0612195	0.9919937	1.1352762

Ages 65+

Hospitalizations

Variable	Rate Ratio	95% Confidence Interval	
age	1.01561775	1.01097384	1.02028300
gender	0.83138269	0.78046608	0.88562103
chron_med	1.52566052	1.10557528	2.10536546
chron_high	4.77072411	3.52483888	6.45697839
income_2	1.41768494	1.25489831	1.60158841
income_3	1.29935307	1.15501400	1.46172982
income_4	1.12802748	1.01033602	1.25942852
income_5	1.13702941	1.01999902	1.26748738
urban	0.95480375	0.88527968	1.02978777
tot_vsts_low	0.76724271	0.69667221	0.84496177
tot_vsts_med	0.80994486	0.74474143	0.88085698
coc_low	0.96960003	0.88560499	1.06156157
coc_med	1.10780373	1.02070103	1.20233945

Hospitalizations for ACSCs

Variable	Rate Ratio	95% Confidence Interval	
age	1.02774040	1.02055944	1.03497189
gender	0.74134808	0.67013829	0.82012472
income_2	1.83496029	1.49920840	2.24590473
income_3	1.65307725	1.35719244	2.01346863
income_4	1.25528003	1.03802302	1.51800868
income_5	0.99383921	0.81755637	1.20813244
urban	0.78106223	0.69049650	0.88350660
tot_vsts_low	0.45730483	0.39001608	0.53620278
tot_vsts_med	0.51035765	0.44056169	0.59121103
coc_low	1.17745972	1.02450695	1.35324742
coc_med	1.28319317	1.12930075	1.45805686

Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	0.9696365	0.9650167	0.9742785
gender	0.8883338	0.8320109	0.9484695
chron_med	1.4396992	1.2129775	1.7087981
chron_high	2.6874422	2.2864949	3.1586974
income_2	0.8927921	0.7885545	1.0108086
income_3	0.8854463	0.7869207	0.9963078
income_4	0.9303969	0.8367054	1.0345797
income_5	0.9655257	0.8703207	1.0711453
urban	1.3329751	1.2321375	1.4420653
tot_vsts_low	0.6909808	0.6321146	0.7553290
tot_vsts_med	0.7927938	0.7301999	0.8607535
coc_low	0.9777388	0.8926630	1.0709228
coc_med	1.0865626	0.9957127	1.1857018

Ambulatory Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	0.9626806	0.9578858	0.9674993
gender	0.8760202	0.8192858	0.9366833
chron_med	1.3027915	1.0832883	1.5667720
chron_high	2.0081716	1.6873350	2.3900133
income_2	0.8259516	0.7276356	0.9375517
income_3	0.8270495	0.7336175	0.9323807
income_4	0.8945521	0.8038750	0.9954577
income_5	0.9575927	0.8628390	1.0627518
urban	1.6720992	1.5426367	1.8124266
tot_vsts_low	0.6822878	0.6219477	0.7484819
tot_vsts_med	0.7289490	0.6697120	0.7934255
coc_low	1.0665358	0.9715652	1.1707898
coc_med	1.0764806	0.9848549	1.1766306

Ages 75+

Hospitalizations

Variable	Rate Ratio	95% Confidence Interval	
age	0.9953229	0.9855574	1.0051852
gender	0.8986015	0.8200254	0.9847070
chron_med	1.1148667	0.7433578	1.6720450
chron_high	3.5289118	2.4351669	5.1139076
income_2	1.5241174	1.2821915	1.8116903
income_3	1.4211698	1.2048620	1.6763112
income_4	1.2221750	1.0466366	1.4271541
income_5	1.1520776	0.9859742	1.3461638
urban	0.9660862	0.8676685	1.0756671
tot_vsts_low	0.7799817	0.6794194	0.8954283
tot_vsts_med	0.8093203	0.7139884	0.9173810
coc_low	0.9457004	0.8329759	1.0736795
coc_med	1.0084191	0.8947988	1.1364668

Hospitalizations for ACSCs

Variable	Rate Ratio	95% Confidence Interval	
age	0.9967949	0.9822580	1.0115469
gender	0.7159862	0.6229481	0.8229197
income_2	2.1272354	1.6074261	2.8151406
income_3	2.0695934	1.5803771	2.7102498
income_4	1.5011081	1.1557563	1.9496547
income_5	1.0247324	0.7757443	1.3536373
urban	0.8202586	0.6934083	0.9703145
tot_vsts_low	0.5655359	0.4605988	0.6943805
tot_vsts_med	0.5155739	0.4171034	0.6372916
coc_low	1.3500337	1.1265299	1.6178807
coc_med	1.2583901	1.0533657	1.5033199

Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	0.9264770	0.9161307	0.9369402
gender	0.8861594	0.7953675	0.9873152
chron_med	1.5884198	1.2071303	2.0901451
chron_high	2.8597022	2.2122409	3.6966575
income_2	0.7997727	0.6554893	0.9758151
income_3	0.8794945	0.7294878	1.0603474
income_4	0.8681596	0.7333851	1.0277016
income_5	0.9540088	0.8084835	1.1257284
urban	1.3643895	1.2014156	1.5494711
tot_vsts_low	0.7567301	0.6541862	0.8753477
tot_vsts_med	0.8253549	0.7195418	0.9467285
coc_low	0.9301541	0.8056822	1.0738560
coc_med	0.9846899	0.8553663	1.1335660

Ambulatory Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	0.9146514	0.9034930	0.9259476
gender	0.9055473	0.8098115	1.0126011
chron_med	1.4098950	1.0409825	1.9095459
chron_high	2.0166503	1.5174194	2.6801281
income_2	0.7795226	0.6344371	0.9577867
income_3	0.8512843	0.7025861	1.0314536
income_4	0.8914923	0.7509299	1.0583658
income_5	1.0228705	0.8652032	1.2092696
urban	1.7536816	1.5370445	2.0008524
tot_vsts_low	0.7431949	0.6372826	0.8667092
tot_vsts_med	0.7969264	0.6907385	0.9194386
coc_low	1.0665394	0.9188912	1.2379119
coc_med	1.0870256	0.9403671	1.2565569

ii) Second Set of Age Groups

Age 12-19

Hospitalizations

Variable	Rate Ratio	95% Confidence Interval	
age	1.03379893	0.99680131	1.07216977
gender	1.98039032	1.61303392	2.43140939
chron_med	1.26331969	1.03990440	1.53473400
chron_high	1.79952628	1.43228067	2.26093592
income_2	2.33198530	1.68546839	3.22649507
income_3	2.44833340	1.79743248	3.33494388
income_4	1.67995570	1.25329422	2.25186640
income_5	1.53221648	1.16291275	2.01879920
urban	0.97200125	0.80034339	1.18047632
tot_vsts_low	0.60007415	0.48612133	0.74073890
tot_vsts_med	0.79609482	0.64168116	0.98766648
coc_low	0.90031075	0.74155686	1.09305096
coc_med	1.20229860	0.97215962	1.48691830

Hospitalizations for ACSCs

Variable	Rate Ratio	95% Confidence Interval	
age	0.99974350	0.87009066	1.14871603
gender	0.91888358	0.45953718	1.83738564
income_2	0.90911519	0.30839501	2.67997346
income_3	0.30942526	0.07674284	1.24759507
income_4	0.47793219	0.16803779	1.35933229
income_5	0.56968081	0.23319999	1.39166480
urban	0.65387875	0.28782074	1.48549901
tot_vsts_low	0.33948246	0.15987231	0.72087743
tot_vsts_med	0.45122282	0.19128173	1.06440913
coc_low	1.15213034	0.56888883	2.33332814
coc_med	0.70288868	0.26809046	1.84285748

Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	1.0169290	0.9955655	1.0387510
gender	1.0176965	0.9183725	1.1277625
chron_med	1.6103323	1.4466211	1.7925703
chron_high	2.0858972	1.7960962	2.4224578
income_2	0.9403141	0.7796434	1.1340962
income_3	0.9624885	0.8047406	1.1511586
income_4	0.9539399	0.8194402	1.1105159
income_5	0.9669351	0.8441979	1.1075170
urban	1.1202281	0.9920674	1.2649453
tot_vsts_low	0.5651909	0.4960358	0.6439873
tot_vsts_med	0.8726556	0.7572273	1.0056792
coc_low	1.0145428	0.9087266	1.1326807
coc_med	1.0964200	0.9606489	1.2513801

Ambulatory Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	1.0520015	1.0250996	1.0796093
gender	1.0327157	0.9105487	1.1712737
chron_med	1.5613638	1.3694258	1.7802038
chron_high	1.9694185	1.6467034	2.3553783
income_2	0.8650051	0.6890616	1.0858736
income_3	0.7398648	0.5941318	0.9213443
income_4	0.8531345	0.7106617	1.0241702
income_5	0.7686637	0.6524895	0.9055223
urban	1.3145274	1.1313910	1.5273079
tot_vsts_low	0.5026158	0.4297539	0.5878309
tot_vsts_med	0.7944963	0.6712711	0.9403419
coc_low	0.9587716	0.8381363	1.0967702
coc_med	0.9903476	0.8430279	1.1634115

Age 20-44

Hospitalizations

Variable	Rate Ratio	95% Confidence Interval	
age	0.9693146	0.9643385	0.9743165
gender	1.6145929	1.4821662	1.7588514
chron_med	1.1670903	1.0604225	1.2844879
chron_high	1.9405937	1.7627036	2.1364363
income_2	1.3142044	1.1447383	1.5087580
income_3	1.2699096	1.1137264	1.4479953
income_4	1.3383697	1.1960932	1.4975701
income_5	1.1475300	1.0290559	1.2796438
urban	1.0357878	0.9487048	1.1308643
tot_vsts_low	0.7150864	0.6529658	0.7831168
tot_vsts_med	0.8124700	0.7404120	0.8915408
coc_low	0.9148753	0.8401030	0.9993025
coc_med	0.9993840	0.9139143	1.0928469

Hospitalizations for ACSCs

Variable	Rate Ratio	95% Confidence Interval	
age	1.0264760	1.0019687	1.0515829
gender	0.4990576	0.3577905	0.6961014
income_2	2.9440560	1.4809618	5.8525921
income_3	3.2930746	1.7059897	6.3566268
income_4	1.6004903	0.8206864	3.1212521
income_5	2.6096761	1.4418563	4.7233620
urban	0.8858299	0.6050937	1.2968151
tot_vsts_low	0.4610338	0.3165507	0.6714634
tot_vsts_med	0.5202846	0.3359080	0.8058638
coc_low	0.9203196	0.6294373	1.3456275
coc_med	0.6974783	0.4456025	1.0917266

Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	1.0158034	1.0127278	1.0188883
gender	1.3399796	1.2811790	1.4014789
chron_med	1.3182005	1.2534201	1.3863290
chron_high	1.9580434	1.8505749	2.0717529
income_2	0.9892484	0.9126009	1.0723334
income_3	0.9620791	0.8915711	1.0381631
income_4	1.0313802	0.9664780	1.1006408
income_5	0.9683279	0.9118203	1.0283375
urban	1.2109269	1.1488688	1.2763372
tot_vsts_low	0.6424728	0.6099844	0.6766916
tot_vsts_med	0.7753682	0.7334229	0.8197123
coc_low	1.0225340	0.9736137	1.0739124
coc_med	1.0739996	1.0180484	1.1330259

Ambulatory Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	1.0070998	1.0032299	1.0109846
gender	1.3144103	1.2413016	1.3918248
chron_med	1.1997771	1.1249233	1.2796117
chron_high	1.7392853	1.6193574	1.8680950
income_2	0.9416452	0.8501229	1.0430205
income_3	0.7925800	0.7193078	0.8733162
income_4	0.9616235	0.8861820	1.0434874
income_5	0.9051848	0.8393302	0.9762064
urban	1.4836198	1.3872152	1.5867241
tot_vsts_low	0.5858898	0.5485895	0.6257264
tot_vsts_med	0.7427612	0.6925144	0.7966537
coc_low	1.0097637	0.9487345	1.0747187
coc_med	1.0993701	1.0274587	1.1763146

Age 45-64

Hospitalizations

Variable	Rate Ratio	95% Confidence Interval	
age	1.03782174	1.03140476	1.04427863
gender	0.82562553	0.76978955	0.88551152
chron_med	1.24661294	1.04754546	1.48350967
chron_high	2.60017022	2.20886118	3.06080130
income_2	1.18556779	1.03341334	1.36012467
income_3	1.18321806	1.03708060	1.34994810
income_4	1.07528940	0.95218113	1.21431444
income_5	1.09820561	0.97769759	1.23356709
urban	0.90769362	0.83391113	0.98800420
tot_vsts_low	0.67930984	0.61833146	0.74630177
tot_vsts_med	0.68899356	0.62896569	0.75475043
coc_low	1.01023052	0.92005277	1.10924692
coc_med	0.97135824	0.88543563	1.06561877

Hospitalizations for ACSCs

Variable	Rate Ratio	95% Confidence Interval	
age	1.06523007	1.05029790	1.08037453
gender	0.68540720	0.58474655	0.80339600
income_2	2.09847427	1.50777470	2.92059170
income_3	1.56232502	1.11913580	2.18102171
income_4	1.42877475	1.04395689	1.95544213
income_5	1.55679866	1.15262131	2.10270455
urban	0.77966201	0.64416369	0.94366209
tot_vsts_low	0.30350215	0.24098786	0.38223317
tot_vsts_med	0.44159513	0.35565614	0.54829999
coc_low	0.72160324	0.56808976	1.06700279
coc_med	0.91887637	0.74558201	1.13244925

Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	1.0177665	1.0139837	1.021563
gender	1.0958528	1.0512596	1.142338
chron_med	1.2086978	1.1274976	1.295746
chron_high	1.8506724	1.7282121	1.981810
income_2	0.9013341	0.8324400	0.975930
income_3	0.9336719	0.8654761	1.007241
income_4	0.9616098	0.8989694	1.028615
income_5	0.9694510	0.9095157	1.033336
urban	1.2326840	1.1720667	1.296436
tot_vsts_low	0.6511960	0.6181478	0.686011
tot_vsts_med	0.7297315	0.6927016	0.768741
coc_low	0.9879552	0.9359036	1.042902
coc_med	1.0216226	0.9675130	1.078759

Ambulatory Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	1.0149414	1.0103762	1.0195271
gender	0.9729639	0.9251582	1.0232399
chron_med	1.1573837	1.0612891	1.2621791
chron_high	1.6721123	1.5361693	1.8200856
income_2	0.7808034	0.7092079	0.8596266
income_3	0.7627989	0.6960107	0.8359960
income_4	0.8261158	0.7621279	0.8954761
income_5	0.8432192	0.7813414	0.9099974
urban	1.4509469	1.3646238	1.5427306
tot_vsts_low	0.5542469	0.5200906	0.5906464
tot_vsts_med	0.6910137	0.6489293	0.7358273
coc_low	1.0083154	0.9440650	1.0769385
coc_med	1.0895008	1.0203492	1.1633389

Age 65-74

Hospitalizations

Variable	Rate Ratio	95% Confidence Interval	
age	1.02549711	1.009888880	1.04134658
gender	0.78385766	0.717843384	0.85594273
chron_med	2.26999407	1.311676307	3.92846393
chron_high	6.90490828	4.072204970	11.70809393
income_2	1.31047288	1.103081151	1.55685661
income_3	1.18822683	1.004530737	1.40551497
income_4	1.04032425	0.889484536	1.21674351
income_5	1.12025304	0.962288170	1.30414871
urban	0.93389143	0.839441329	1.03896863
tot_vsts_low	0.75549675	0.659893718	0.86495041
tot_vsts_med	0.81319772	0.726191467	0.91062835
coc_low	0.99575375	0.874677381	1.13358999
coc_med	1.20586755	1.077492448	1.34953759

Hospitalizations for ACSCs

Variable	Rate Ratio	95% Confidence Interval	
age	1.08570167	1.054079876	1.11827210
gender	0.80640954	0.691340803	0.94063063
income_2	1.43322525	1.053204621	1.95036613
income_3	1.20499834	0.888028168	1.63510692
income_4	0.97653675	0.728973676	1.30817347
income_5	0.93576224	0.700613088	1.24983529
urban	0.69583891	0.573778442	0.84386541
tot_vsts_low	0.36700963	0.283670191	0.47483334
tot_vsts_med	0.47692184	0.382404291	0.59480097
coc_low	1.05104370	0.838328028	1.31773341
coc_med	1.33451501	1.099745771	1.61940183

Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	1.0023600	0.9882587	1.0166625
gender	0.9085140	0.8376365	0.9853889
chron_med	1.3085113	1.0514408	1.6284339
chron_high	2.4762610	2.0115983	3.0482570
income_2	0.9707123	0.8293232	1.1362066
income_3	0.9078521	0.7808761	1.0554752
income_4	0.9929197	0.8672381	1.1368153
income_5	0.9873764	0.8651810	1.1268303
urban	1.3117339	1.1880323	1.4483158
tot_vsts_low	0.6655132	0.5955103	0.7437450
tot_vsts_med	0.7761808	0.7014941	0.8588193
coc_low	1.0132638	0.9016186	1.1387337
coc_med	1.1969815	1.0723035	1.3361560

Ambulatory Specialist Contacts

Variable	Rate Ratio	95% Confidence Interval	
age	0.9990563	0.9847561	1.0135642
gender	0.8677402	0.7989366	0.9424691
chron_med	1.1912494	0.9444051	1.5026127
chron_high	1.9048777	1.5282338	2.3743481
income_2	0.8493480	0.7241662	0.9961692
income_3	0.8115010	0.6969466	0.9448844
income_4	0.9062956	0.7914659	1.0377854
income_5	0.9276486	0.8129382	1.0585454
urban	1.6124460	1.4577454	1.7835638
tot_vsts_low	0.6502190	0.5797195	0.7292920
tot_vsts_med	0.7045503	0.6351991	0.7814732
coc_low	1.0636142	0.9444106	1.1978638
coc_med	1.0901834	0.9751995	1.2187248

2) Cost of Health Services (Phase II Only) (MCP Sample)

Two types of models were used to model health care service cost outcomes. Tobit was used to model FP, specialist, and total physician cost. Ordinary least squares (OLS) regression was used to model hospital cost. All data was log-transformed to attain normality. In Tobit models cases with $0 cost were censored. For OLS regression models cases with $0 cost were excluded from analyses.

Exponentiated beta-coefficients and their 95% confidence intervals for all models are presented below.

A) MCP Cross-sectional Analysis (Continuity of Care and Outcomes 1999-2002)

i) First Set of Age Groups

Age 12+

FP Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0033884	1.0031488	1.0036281
gender	1.1069960	1.0981533	1.1159100
chron_med	1.0529649	1.0421710	1.0638705
chron_high	1.2008582	1.1868883	1.2149925
income_2	1.0286466	1.0133840	1.0441391
income_3	1.0634942	1.0485059	1.0786968
income_4	1.0140365	1.0014898	1.0267405
income_5	1.0122929	1.0005465	1.0241773
urban	1.0010105	0.9913928	1.0107214
tot_vsts_low	0.2067780	0.2045703	0.2090096
tot_vsts_med	0.4732293	0.4684670	0.4780401
coc_low	1.0014340	0.9921456	1.0108095
coc_med	1.0226585	1.0124138	1.0330070

Specialist Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0182833	1.0170660	1.0195020
gender	1.2998197	1.2486156	1.3531236
chron_med	1.5515803	1.4732943	1.6340261
chron_high	2.6478126	2.4970813	2.8076425
income_2	0.8846548	0.8208238	0.9534496
income_3	0.8866801	0.8258287	0.9520153
income_4	0.8620173	0.8098888	0.9175010
income_5	0.8882547	0.8378028	0.9417447
urban	1.2338353	1.1755731	1.2949850
tot_vsts_low	0.2017871	0.1912340	0.2129226
tot_vsts_med	0.5418918	0.5152150	0.5699500
coc_low	0.9497728	0.9064228	0.9951960
coc_med	1.0718278	1.0191436	1.1272355

Total Physician Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0096679	1.0092281	1.0101079
gender	1.1323422	1.1158976	1.1490291
chron_med	1.1447645	1.1234500	1.1664834
chron_high	1.5192515	1.4871683	1.5520268
income_2	0.9890772	0.9624723	1.0164176
income_3	0.9853406	0.9601577	1.0111840
income_4	0.9635328	0.9418979	0.9856647
income_5	0.9669049	0.9465376	0.9877105
urban	1.1066643	1.0873466	1.1263252
tot_vsts_low	0.2613923	0.2563241	0.2665607
tot_vsts_med	0.5412164	0.5313230	0.5512940
coc_low	0.9793089	0.9628040	0.9960967
coc_med	1.0295424	1.0108075	1.0486245

Hospital Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0164687	1.0149790	1.0179606
gender	0.8904672	0.8430491	0.9405523
chron_med	0.9995944	0.9219365	1.0837936
chron_high	1.2729783	1.1723519	1.3822418
income_2	1.0330481	0.9357160	1.1405045
income_3	1.0127467	0.9216197	1.1128839
income_4	0.9532515	0.8757177	1.0376498
income_5	1.0215353	0.9414497	1.1084335
urban	1.0903640	1.0240574	1.1609640
tot_vsts_low	0.9419517	0.8778668	1.0107149
tot_vsts_med	0.8759144	0.8232747	0.9319197
coc_low	1.0327871	0.9697000	1.0999786
coc_med	1.0587682	0.9913535	1.1307672

Age 55+

FP Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0116611	1.0107583	1.0125647
gender	1.0205087	1.0038038	1.0374916
chron_med	1.0735197	1.0377104	1.1105646
chron_high	1.2799728	1.2385830	1.3227457
income_2	1.0249711	0.9932100	1.0577478
income_3	1.0582501	1.0268314	1.0906302
income_4	1.0123069	0.9850664	1.0403006
income_5	1.0111166	0.9847808	1.0381567
urban	0.9907173	0.9710824	1.0107492
tot_vsts_low	0.2221114	0.2171032	0.2272350
tot_vsts_med	0.4679789	0.4588739	0.4772646
coc_low	0.9829875	0.9618615	1.0045774
coc_med	1.0012611	0.9800966	1.0228826

Specialist Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9956574	0.9919815	0.9993468
gender	0.9008173	0.8413299	0.9645108
chron_med	1.4046886	1.2199270	1.6174329
chron_high	3.3946229	2.9611816	3.8915090
income_2	0.8176296	0.7177521	0.9314054
income_3	0.8239356	0.7273161	0.9333904
income_4	0.8505322	0.7597566	0.9521536
income_5	0.8827586	0.7914292	0.9846271
urban	1.4632716	1.3469058	1.5896907
tot_vsts_low	0.3444776	0.3134156	0.3786182
tot_vsts_med	0.5948914	0.5484543	0.6452604
coc_low	1.1632118	1.0631829	1.2726519
coc_med	1.1187658	1.0241016	1.2221805

Total Physician Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0079158	1.0063307	1.0095035
gender	0.9189037	0.8925523	0.9460332
chron_med	1.1438433	1.0774375	1.2143419
chron_high	1.7621363	1.6629256	1.8672659
income_2	0.9319212	0.8816155	0.9850973
income_3	0.9297757	0.8816639	0.9805128
income_4	0.9273795	0.8838384	0.9730656
income_5	0.9703320	0.9262207	1.0165442
urban	1.1571235	1.1170010	1.1986872
tot_vsts_low	0.3387552	0.3254059	0.3526522
tot_vsts_med	0.5636673	0.5444775	0.5835334
coc_low	1.0188471	0.9805623	1.0586266
coc_med	1.0338664	0.9956514	1.0735481

Hospital Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0227579	1.0185237	1.0270097
gender	0.8006266	0.7408219	0.8652593
chron_med	0.9715379	0.7787812	1.2120040
chron_high	1.4630032	1.1900757	1.7985228
income_2	1.0692272	0.9203357	1.2422063
income_3	1.0358278	0.8972065	1.1958665
income_4	0.9945077	0.8706004	1.1360499
income_5	1.0367114	0.9120880	1.1783627
urban	1.0974221	0.9986261	1.2059923
tot_vsts_low	1.0515402	0.9431167	1.1724284
tot_vsts_med	0.8626283	0.7845149	0.9485194
coc_low	1.0662036	0.9631272	1.1803115
coc_med	1.1170367	1.0092465	1.2363392

Age 65+

FP Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0132743	1.0115194	1.0150322
gender	1.0106042	0.9867077	1.0350795
chron_med	1.0982089	1.0382440	1.1616372
chron_high	1.3614184	1.2906273	1.4360923
income_2	1.0273731	0.9818295	1.0750293
income_3	1.0736926	1.0282635	1.1211288
income_4	1.0201274	0.9810405	1.0607716
income_5	1.0125069	0.9746702	1.0518124
urban	0.9809724	0.9530940	1.0096664
tot_vsts_low	0.2270084	0.2196136	0.2346523
tot_vsts_med	0.4681402	0.4550352	0.4816227
coc_low	0.9766911	0.9467128	1.0076187
coc_med	0.9855828	0.9555346	1.0165759

Specialist Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9764614	0.9700228	0.9829427
gender	0.7460576	0.6810386	0.8172839
chron_med	1.8002382	1.4516745	2.2324962
chron_high	4.6401839	3.7813852	5.6940264
income_2	0.8848757	0.7444902	1.0517330
income_3	0.8599322	0.7293456	1.0138998
income_4	0.8890172	0.7660991	1.0316572
income_5	0.8630261	0.7464559	0.9978004
urban	1.6732706	1.4991844	1.8675717
tot_vsts_low	0.4366962	0.3848678	0.4955042
tot_vsts_med	0.6430323	0.5771195	0.7164729
coc_low	1.2286296	1.0910481	1.3835601
coc_med	1.1041932	0.9813251	1.2424451

Total Physician Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0002359	0.9974246	1.0030552
gender	0.8689281	0.8358124	0.9033560
chron_med	1.2247149	1.1179922	1.3416253
chron_high	1.9217738	1.7621628	2.0958418
income_2	0.9633531	0.8949736	1.0369570
income_3	0.9535966	0.8889508	1.0229435
income_4	0.9427055	0.8847589	1.0044473
income_5	0.9777458	0.9191121	1.0401199
urban	1.2131983	1.1577121	1.2713438
tot_vsts_low	0.3797468	0.3598653	0.4007267
tot_vsts_med	0.5793413	0.5532378	0.6066763
coc_low	1.0442033	0.9926612	1.0984217
coc_med	1.0230873	0.9729231	1.0758380

Hospital Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0160852	1.0087571	1.0234665
gender	0.8034838	0.7279949	0.8868006
chron_med	0.9293049	0.6821500	1.2660084
chron_high	1.5172972	1.1385903	2.0219660
income_2	1.0529569	0.8714249	1.2723048
income_3	1.0352292	0.8640277	1.2403533
income_4	0.9470185	0.8018530	1.1184642
income_5	1.0006713	0.8510952	1.1765347
urban	1.0900727	0.9672910	1.2284395
tot_vsts_low	1.0689702	0.9329370	1.2248385
tot_vsts_med	0.8753797	0.7749166	0.9888673
coc_low	1.0713140	0.9432183	1.2168059
coc_med	1.1016450	0.9671149	1.2548889

Age 75+

FP Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0158812	1.0115226	1.0202585
gender	1.0093944	0.9678080	1.0527678
chron_med	1.0808740	0.9802059	1.1918808
chron_high	1.3736015	1.2531272	1.5056582
income_2	1.0836476	1.0029534	1.1708342
income_3	1.0718562	0.9964565	1.1529612
income_4	1.0389582	0.9725166	1.1099391
income_5	1.0328471	0.9681392	1.1018800
urban	0.9839642	0.9363217	1.0340309
tot_vsts_low	0.2285438	0.2161004	0.2417037
tot_vsts_med	0.4588632	0.4367168	0.4821326
coc_low	0.9582806	0.9093023	1.0098970
coc_med	0.9579233	0.9088702	1.0096238

Specialist Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9301764	0.9166221	0.9439311
gender	0.7206456	0.6245522	0.8315239
chron_med	3.061477	2.1875808	4.284479
chron_high	8.238276	6.0075498	11.29732
income_2	0.9002390	0.6919145	1.171287
income_3	0.9099689	0.7099983	1.166261
income_4	0.9223654	0.7367057	1.154814
income_5	0.9479605	0.7606590	1.181382
urban	1.666776	1.4078106	1.973378
tot_vsts_low	0.5272182	0.4356732	0.6379988
tot_vsts_med	0.7484087	0.6325481	0.8854909
coc_low	1.293382	1.0819854	1.546081
coc_med	1.094337	0.9151412	1.308622

Total Physician Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9855097	0.9796667	0.9913876
gender	0.8405190	0.7930073	0.8908773
chron_med	1.3343739	1.1656203	1.5275590
chron_high	2.0611833	1.8154370	2.3401950
income_2	0.9627415	0.8650271	1.0714939
income_3	0.9557434	0.8640311	1.0571904
income_4	0.9555947	0.8721260	1.0470519
income_5	1.0054273	0.9193691	1.0995411
urban	1.2071126	1.1270355	1.2928792
tot_vsts_low	0.3876952	0.3588093	0.4189066
tot_vsts_med	0.5881499	0.5492575	0.6297962
coc_low	1.0771527	1.0017647	1.1582140
coc_med	1.0066214	0.9360372	1.0825282

Hospital Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0025418	0.9880470	1.017249
gender	0.8320146	0.7271528	0.951998
chron_med	0.8826287	0.5733417	1.358759
chron_high	1.3032137	0.8721369	1.947362
income_2	1.0716596	0.8320608	1.380253
income_3	1.0390810	0.8176808	1.320429
income_4	0.9850328	0.7884947	1.230559
income_5	1.0444301	0.8393889	1.299558
urban	1.0522017	0.8954775	1.236355
tot_vsts_low	1.0369098	0.8666335	1.240642
tot_vsts_med	0.8431577	0.7150858	0.994167
coc_low	1.2305045	1.0410463	1.454442
coc_med	1.1949567	1.0050970	1.420680

ii) Second Set of Age Groups

Age 12-29

FP Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9950532	0.9902605	0.9998690
gender	1.1266526	1.1003438	1.1535906
chron_med	1.0703738	1.0443524	1.0970435
chron_high	1.1666630	1.1237882	1.2111736
income_2	1.0381256	0.9949140	1.0832139
income_3	1.0643072	1.0217526	1.1086342
income_4	0.9961484	0.9620660	1.0314381
income_5	1.0178175	0.9865688	1.0500558
urban	0.9811273	0.9542698	1.0087407
tot_vsts_low	0.2112386	0.2038223	0.2189247
tot_vsts_med	0.4962039	0.4786795	0.5143700
coc_low	1.0057398	0.9802807	1.0318602
coc_med	1.0577637	1.0255999	1.0909362

Specialist Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9480457	0.91848116	0.9785620
gender	0.7410123	0.63452520	0.8653702
chron_med	2.1552369	1.83451551	2.5320288
chron_high	4.4631893	3.50158739	5.6888652
income_2	1.0188580	0.77143063	1.3456448
income_3	0.8272932	0.63319425	1.0808911
income_4	0.7297568	0.58073612	0.9170171
income_5	0.9024766	0.73577325	1.1069497
urban	1.0551975	0.87961732	1.2658252
tot_vsts_low	0.1052437	0.08340826	0.1327955
tot_vsts_med	0.3609943	0.28600703	0.4556423
coc_low	0.7625432	0.64459926	0.9020676
coc_med	0.8470098	0.69193566	1.0368385

Total Physician Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9959433	0.9873636	1.0045977
gender	1.0506858	1.0071262	1.0961295
chron_med	1.2261194	1.1732190	1.2814051
chron_high	1.5387902	1.4389299	1.6455806
income_2	1.0384739	0.9622930	1.1206858
income_3	1.0137156	0.9422355	1.0906183
income_4	0.9628819	0.9046475	1.0248650
income_5	0.9860199	0.9324326	1.0426870
urban	1.0160124	0.9667135	1.0678252
tot_vsts_low	0.2271605	0.2130680	0.2421851
tot_vsts_med	0.5065211	0.4749136	0.5402322
coc_low	0.9344978	0.8925322	0.9784366
coc_med	1.0082252	0.9539497	1.0655887

Hospital Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0462485	1.0112421	1.082467
gender	0.9888723	0.8229734	1.188214
chron_med	1.0077257	0.8433726	1.204107
chron_high	1.1766699	0.9499991	1.457425
income_2	1.1765651	0.8735968	1.584605
income_3	1.1919426	0.8952739	1.586919
income_4	1.0419813	0.8020940	1.353613
income_5	1.1437546	0.8971186	1.458196
urban	0.9799253	0.8124163	1.181972
tot_vsts_low	0.9130744	0.7362587	1.132353
tot_vsts_med	0.8775941	0.7192168	1.070847
coc_low	1.0374053	0.8676927	1.240312
coc_med	0.9643439	0.7822226	1.188868

Age 20-44

FP Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9988966	0.9980875	0.9997065
gender	1.1597469	1.1460242	1.1736339
chron_med	1.0679240	1.0540088	1.0820230
chron_high	1.1906755	1.1719256	1.2097253
income_2	1.0379733	1.0157192	1.0607149
income_3	1.0672479	1.0457242	1.0892147
income_4	1.0106419	0.9930850	1.0285092
income_5	1.0104350	0.9941627	1.0269737
urban	1.0024724	0.9884570	1.0166864
tot_vsts_low	0.2020922	0.1989727	0.2052606
tot_vsts_med	0.4784577	0.4712385	0.4857876
coc_low	0.9979600	0.9851461	1.0109406
coc_med	1.0290561	1.0143233	1.0440029

Specialist Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0277937	1.0231785	1.0324298
gender	1.6337106	1.5292083	1.7453543
chron_med	1.4451116	1.3435257	1.5543785
chron_high	2.1060114	1.9288632	2.2994290
income_2	0.9347683	0.8288528	1.0542184
income_3	0.9382887	0.8380107	1.0505661
income_4	0.8767349	0.7954837	0.9662850
income_5	0.8914107	0.8146163	0.9754447
urban	1.1552644	1.0684329	1.2491528
tot_vsts_low	0.1472302	0.1350756	0.1604785
tot_vsts_med	0.4809716	0.4422600	0.5230717
coc_low	0.9407298	0.8755890	1.0107169
coc_med	1.0562341	0.9750727	1.1441510

Total Physician Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0065937	1.0050874	1.0081022
gender	1.2773090	1.2495204	1.3057157
chron_med	1.1407769	1.1134605	1.1687635
chron_high	1.4093327	1.3685959	1.4512820
income_2	1.0235958	0.9834109	1.0654227
income_3	1.0149990	0.9774961	1.0539407
income_4	0.9754850	0.9444009	1.0075921
income_5	0.9726973	0.9439483	1.0023217
urban	1.0854673	1.0575904	1.1140791
tot_vsts_low	0.2363001	0.2296039	0.2431916
tot_vsts_med	0.5274098	0.5127985	0.5424374
coc_low	0.9711014	0.9481853	0.9945713
coc_med	1.0319446	1.0048092	1.0598129

Hospital Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9985128	0.9919929	1.0050755
gender	0.9820642	0.8824077	1.0929755
chron_med	1.1290534	1.0161909	1.2544508
chron_high	1.2946132	1.1544410	1.4518051
income_2	0.9603156	0.8134295	1.1337258
income_3	0.9332012	0.7980491	1.0912417
income_4	0.8529997	0.7450331	0.9766122
income_5	0.9741173	0.8556535	1.1089821
urban	1.0472800	0.9419922	1.1643359
tot_vsts_low	0.9526364	0.8462778	1.0723619
tot_vsts_med	0.9154013	0.8270112	1.0132385
coc_low	0.9173799	0.8299371	1.0140358
coc_med	1.0089094	0.9062324	1.1232197

Age 45-64

FP Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0046432	1.0034268	1.0058611
gender	1.0588963	1.0446989	1.0732866
chron_med	1.0658418	1.0438633	1.0882832
chron_high	1.2072630	1.1816419	1.2334397
income_2	1.0161329	0.9903115	1.0426276
income_3	1.0546704	1.0290403	1.0809387
income_4	1.0186337	0.9965256	1.0412323
income_5	1.0132587	0.9923354	1.0346232
urban	1.0103282	0.9938796	1.0270491
tot_vsts_low	0.2121152	0.2082421	0.2160602
tot_vsts_med	0.4695575	0.4619210	0.4773203
coc_low	0.9827441	0.9661561	0.9996170
coc_med	1.0100030	0.9929844	1.0273133

Specialist Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0196937	1.0139624	1.0254574
gender	1.4480373	1.3599032	1.5418832
chron_med	1.2234515	1.1101858	1.3482729
chron_high	2.2307324	2.0186038	2.4651530
income_2	0.7669737	0.6803976	0.8645661
income_3	0.8186459	0.7301270	0.9178967
income_4	0.8336838	0.7527941	0.9232653
income_5	0.8755869	0.7946174	0.9648070
urban	1.2538130	1.1616203	1.3533225
tot_vsts_low	0.2761512	0.2534613	0.3008722
tot_vsts_med	0.5558416	0.5150667	0.5998445
coc_low	1.0515201	0.9714472	1.1381931
coc_med	1.1492663	1.0619600	1.2437503

Total Physician Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0158686	1.0134599	1.0182830
gender	1.0985507	1.0698758	1.1279941
chron_med	1.0993146	1.0553362	1.1451257
chron_high	1.4996362	1.4379104	1.5640117
income_2	0.9199719	0.8747233	0.9675613
income_3	0.9317186	0.8878704	0.9777323
income_4	0.9312099	0.8920209	0.9721206
income_5	0.9367391	0.8992130	0.9758312
urban	1.1184319	1.0830320	1.1549888
tot_vsts_low	0.2848710	0.2747684	0.2953452
tot_vsts_med	0.5349673	0.5180528	0.5524341
coc_low	0.9853600	0.9530343	1.0187821
coc_med	1.0292058	0.9954997	1.0640531

Hospital Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0290876	1.0203112	1.0379394
gender	0.8076043	0.7320582	0.8909466
chron_med	0.9814476	0.8051836	1.1962979
chron_high	1.2736934	1.0538349	1.5394204
income_2	1.0686096	0.8848614	1.2905143
income_3	1.0556539	0.8811402	1.2647306
income_4	1.0878003	0.9219029	1.2835510
income_5	1.0836370	0.9233639	1.2717295
urban	1.1588774	1.0297766	1.3041633
tot_vsts_low	0.9201352	0.8005703	1.0575569
tot_vsts_med	0.8621480	0.7671737	0.9688798
coc_low	1.0901361	0.9598113	1.2381565
coc_med	1.0568057	0.9340127	1.1957421

Age 65-74

FP Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0131821	1.0082643	1.0181238
gender	1.0099116	0.9821447	1.0384636
chron_med	1.1068932	1.0363131	1.1822802
chron_high	1.3525844	1.2695047	1.4411011
income_2	0.9891155	0.9371510	1.0439615
income_3	1.0732870	1.0190401	1.1304216
income_4	1.0041391	0.9582079	1.0522720
income_5	0.9944833	0.9502534	1.0407719
urban	0.9808461	0.9479695	1.0148630
tot_vsts_low	0.2251760	0.2164018	0.2343059
tot_vsts_med	0.4737024	0.4581815	0.4897490
coc_low	0.9898814	0.9534171	1.0277404
coc_med	1.0065733	0.9700259	1.0444977

Specialist Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0276437	1.0068656	1.0488505
gender	0.7898924	0.7026419	0.8879771
chron_med	1.1580095	0.8774110	1.5283443
chron_high	2.7209336	2.0836247	3.5531733
income_2	0.8428514	0.6719996	1.0571413
income_3	0.8171973	0.6573460	1.0159207
income_4	0.8682710	0.7134048	1.0567555
income_5	0.8109039	0.6699505	0.9815129
urban	1.6583510	1.4371927	1.9135415
tot_vsts_low	0.3810106	0.3224026	0.4502727
tot_vsts_med	0.5812756	0.5054330	0.6684988
coc_low	1.2062448	1.0304596	1.4120169
coc_med	1.1378610	0.9742495	1.3289488

Total Physician Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0181328	1.0089475	1.0274017
gender	0.8970275	0.8516352	0.9448393
chron_med	1.1305372	0.9999704	1.2781521
chron_high	1.7650382	1.5684716	1.9862394
income_2	0.9577257	0.8661370	1.0589993
income_3	0.9523165	0.8646236	1.0489035
income_4	0.9354535	0.8573298	1.0206962
income_5	0.9610111	0.8829316	1.0459952
urban	1.2162839	1.1414486	1.2960256
tot_vsts_low	0.3760813	0.3492457	0.4049789
tot_vsts_med	0.5756996	0.5410629	0.6125535
coc_low	1.0246968	0.9555085	1.0988950
coc_med	1.0458364	0.9762174	1.1204202

Hospital Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0339748	1.0083009	1.0603024
gender	0.7796653	0.6747809	0.9008524
chron_med	0.9687288	0.6215786	1.5097615
chron_high	1.7209622	1.1399350	2.5981402
income_2	1.0376067	0.7826481	1.3756218
income_3	1.0516275	0.8014899	1.3798306
income_4	0.9160204	0.7148068	1.1738743
income_5	0.9677105	0.7617025	1.2294349
urban	1.1268996	0.9440724	1.3451326
tot_vsts_low	1.1255647	0.9155793	1.3837095
tot_vsts_med	0.9130584	0.7626580	1.0931185
coc_low	0.9226983	0.7599728	1.1202666
coc_med	1.0236054	0.8418457	1.2446082

B) MCP Longitudnal Analysis (Continuity of Care 1999-2000 and Outcomes 2001-2002)

i) First Set of Age Groups

Age 12+

FP Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9941664	0.9932659	0.9950677
gender	1.4037137	1.3612632	1.4474879
chron_med	1.5968664	1.5325589	1.6638722
chron_high	2.5868129	2.4749606	2.7037201
income_2	0.8198704	0.7742547	0.8681736
income_3	0.8892848	0.8422329	0.9389653
income_4	0.9607661	0.9161215	1.0075863
income_5	0.9945962	0.9512431	1.0399252
urban	1.1145596	1.0742235	1.1564102
tot_vsts_low	0.3213607	0.3094931	0.3336835
tot_vsts_med	0.5684049	0.5466585	0.5910164
coc_low	0.8942420	0.8620504	0.9276356
coc_med	0.9746350	0.9372609	1.0134995

Specialist Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0149880	1.0131633	1.0168159
gender	1.8212532	1.7133591	1.9359416
chron_med	2.2103620	2.0352805	2.4005045
chron_high	5.2224308	4.7815916	5.7039131
income_2	0.7220800	0.6445144	0.8089804
income_3	0.7542690	0.6771731	0.8401422
income_4	0.8260556	0.7516672	0.9078057
income_5	0.8049349	0.7367663	0.8794108
urban	1.2987252	1.2070955	1.3973104
tot_vsts_low	0.3397549	0.3153194	0.3660840
tot_vsts_med	0.5790790	0.5361137	0.6254875
coc_low	0.9495120	0.8827568	1.0213154
coc_med	1.0801532	0.9995883	1.1672115

Total Physician Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0008452	0.9998758	1.0018155
gender	1.4111387	1.3655358	1.4582645
chron_med	1.6631230	1.5916134	1.7378454
chron_high	2.8937639	2.7601478	3.0338482
income_2	0.8393317	0.7894762	0.8923355
income_3	0.8731665	0.8238292	0.9254584
income_4	0.9318333	0.8855698	0.9805137
income_5	0.9344629	0.8909334	0.9801191
urban	1.1817733	1.1360719	1.2293132
tot_vsts_low	0.3800573	0.3650621	0.3956684
tot_vsts_med	0.6257888	0.6001952	0.6524737
coc_low	0.9244550	0.8889057	0.9614261
coc_med	1.0081654	0.9668516	1.0512446

Hospital Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0156837	1.0129037	1.0184713
gender	0.8711157	0.7888995	0.9619002
chron_med	0.9357407	0.7957340	1.1003810
chron_high	1.1878339	1.0107637	1.3959242
income_2	1.0410703	0.8707200	1.2447485
income_3	1.0356540	0.8754065	1.2252356
income_4	0.9127474	0.7836160	1.0631583
income_5	1.0320990	0.8914657	1.1949179
urban	1.1472442	1.0248176	1.2842962
tot_vsts_low	0.9948419	0.8813722	1.1229201
tot_vsts_med	0.9909390	0.8784826	1.1177913
coc_low	1.1351242	1.0070224	1.2795215
coc_med	1.1038358	0.9770135	1.2471204

Age 55+

Variable	Exp(β)	95% Confidence Interval	
FP Cost			
age	0.9652310	0.9618274	0.9686466
gender	1.2563929	1.1771067	1.3410197
chron_med	2.0460915	1.7650989	2.3718163
chron_high	3.7183824	3.2302344	4.2802987
income_2	0.7267212	0.6415799	0.8231613
income_3	0.7829213	0.6951448	0.8817813
income_4	0.9188208	0.8254663	1.0227332
income_5	0.9141919	0.8241266	1.0141000
urban	1.1079144	1.0238824	1.1988431
tot_vsts_low	0.2871594	0.2635193	0.3129203
tot_vsts_med	0.5236966	0.4825467	0.5683556
coc_low	0.7980742	0.7292556	0.8733870
coc_med	0.8853560	0.8107884	0.9667816

Specialist Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9482336	0.9428144	0.9536839
gender	1.2236270	1.1013759	1.3594477
chron_med	2.1116814	1.6586933	2.6883802
chron_high	6.8382792	5.4327666	8.6074125
income_2	0.6378750	0.5217127	0.7799014
income_3	0.6601947	0.5450265	0.7996987
income_4	0.7542428	0.6346570	0.8963616
income_5	0.7167287	0.6063681	0.8471751
urban	1.6989869	1.4957933	1.9297830
tot_vsts_low	0.3837344	0.3339261	0.4409721
tot_vsts_med	0.5779829	0.5064276	0.6596485
coc_low	1.0885543	0.9412697	1.2588853
coc_med	1.0609432	0.9204597	1.2228676

Total Physician Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9589638	0.9553343	0.9626071
gender	1.1696834	1.0905609	1.2545464
chron_med	2.1458891	1.8318293	2.5137931
chron_high	4.4911030	3.8626309	5.2218310
income_2	0.7291679	0.6377889	0.8336392
income_3	0.7664496	0.6745072	0.8709247
income_4	0.8762745	0.7809398	0.9832473
income_5	0.8444718	0.7553570	0.9441002
urban	1.2552220	1.1531983	1.3662718
tot_vsts_low	0.3843269	0.3504748	0.4214488
tot_vsts_med	0.5991735	0.5487156	0.6542712
coc_low	0.9251778	0.8398160	1.0192160
coc_med	0.9730606	0.8852651	1.0695633

Hospital Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0125317	1.0053914	1.019723
gender	0.8043626	0.7072235	0.914844
chron_med	1.0012233	0.6079822	1.648811
chron_high	1.4562724	0.9124001	2.324341
income_2	1.1568867	0.9029707	1.482204
income_3	1.0346646	0.8177939	1.309047
income_4	1.0232448	0.8213166	1.274819
income_5	0.9882251	0.8013308	1.218709
urban	1.2685260	1.0855178	1.482388
tot_vsts_low	0.9067054	0.7550420	1.088833
tot_vsts_med	0.8617517	0.7278096	1.020344
coc_low	1.1318178	0.9424627	1.359217
coc_med	1.1745296	0.9866965	1.398120

Age 65+

FP Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9411883	0.9342124	0.9482162
gender	1.3331708	1.2039785	1.4762260
chron_med	2.6389229	2.0263288	3.4367149
chron_high	5.5255803	4.3062360	7.0901913
income_2	0.6004119	0.4949532	0.7283406
income_3	0.6834732	0.5689280	0.8210803
income_4	0.8796233	0.7457180	1.0375733
income_5	0.8857051	0.7535095	1.0410931
urban	1.0956936	0.9696359	1.2381395
tot_vsts_low	0.2715635	0.2364788	0.3118536
tot_vsts_med	0.5190777	0.4568187	0.5898219
coc_low	0.7643295	0.6634027	0.8806108
coc_med	0.8654987	0.7554563	0.9915703

Specialist Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9100631	0.9000110	0.9202275
gender	1.029681	0.8853869	1.197492
chron_med	3.411199	2.2870761	5.087841
chron_high	12.87653	8.8243947	18.78939
income_2	0.6299111	0.4733366	0.8382788
income_3	0.6579586	0.5016744	0.8629292
income_4	0.7865459	0.6162396	1.003919
income_5	0.6696702	0.5272163	0.8506152
urban	2.072349	1.7290325	2.483835
tot_vsts_low	0.4569856	0.3721238	0.5612000
tot_vsts_med	0.6092397	0.5040803	0.7363372
coc_low	1.080632	0.8763859	1.332480
coc_med	1.024203	0.8373022	1.252824

Total Physician Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9272418	0.9198959	0.9346464
gender	1.194713	1.0712371	1.332422
chron_med	3.291130	2.4837658	4.360933
chron_high	7.589328	5.8186660	9.898816
income_2	0.6444903	0.5241329	0.7924855
income_3	0.6718358	0.5520459	0.8176191
income_4	0.8478577	0.7103887	1.011929
income_5	0.8060043	0.6778375	0.9584050
urban	1.297931	1.1387011	1.479426
tot_vsts_low	0.3936350	0.3395749	0.4563014
tot_vsts_med	0.5974858	0.5210870	0.6850856
coc_low	0.9099922	0.7821644	1.058711
coc_med	0.9469250	0.8186386	1.095315

Hospital Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0077060	0.9951366	1.0204342
gender	0.7853842	0.6650537	0.9274866
chron_med	1.3938293	0.6361295	3.0540322
chron_high	2.3720172	1.1300174	4.9790962
income_2	1.2816401	0.9343819	1.7579550
income_3	1.0293108	0.7632687	1.3880835
income_4	1.0454594	0.7907269	1.3822537
income_5	0.9347686	0.7144296	1.2230628
urban	1.3319409	1.0904062	1.6269778
tot_vsts_low	0.7953820	0.6236853	1.0143458
tot_vsts_med	0.8476599	0.6809169	1.0552350
coc_low	1.1189715	0.8800177	1.4228093
coc_med	1.1611218	0.9314206	1.4474704

Age 75+

Variable	Exp(β)	95% Confidence Interval	
FP Cost			
age	0.8988954	0.8808288	0.9173326
gender	1.722917	1.415523	2.097065
chron_med	3.485605	2.118674	5.734454
chron_high	8.492428	5.327607	13.53729
income_2	0.5065749	0.3531718	7.266099
income_3	0.6201272	0.4417363	0.8705595
income_4	0.7945371	0.5852439	1.078677
income_5	0.8480042	0.6279826	1.145113
urban	1.196726	0.9503985	1.506899
tot_vsts_low	0.2250040	0.1726113	0.2932994
tot_vsts_med	0.5495711	0.4287670	0.7044115
coc_low	0.6602008	0.5086592	0.8568904
coc_med	0.7819128	0.6055121	1.009703

Specialist Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.8254919	1 8.033643	0.8482289
gender	1.231678	0.9510587	1.595096
chron_med	4.162749	2.118023	8.181442
chron_high	19.02169	10.08885	35.86380
income_2	0.5592307	0.3479212	0.8988789
income_3	0.6278368	0.4021051	0.9802886
income_4	0.7180352	0.4805781	1.072821
income_5	0.6718154	0.4525358	0.9973485
urban	2.262090	1.669012	3.065917
tot_vsts_low	0.4970846	0.3504448	0.7050842
tot_vsts_med	0.6836638	0.4926786	0.9486839
coc_low	0.8905580	0.6318187	1.255255
coc_med	0.8651557	0.6177584	1.211630

Total Physician Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.8645140	0.8463705	0.8830465
gender	1.566758	1.275735	1.924171
chron_med	4.441430	2.647960	7.449623
chron_high	11.57289	7.129541	18.78549
income_2	0.5102007	0.3498207	0.7441089
income_3	0.6005049	0.4210447	0.8564557
income_4	0.7800841	0.5663459	1.074487
income_5	0.7456790	0.5443011	1.021562
urban	1.319577	1.036661	1.679704
tot_vsts_low	0.3634455	0.2758109	0.4789245
tot_vsts_med	0.5889592	0.4541496	0.7637857
coc_low	0.8064851	0.6142698	1.058848
coc_med	0.8153574	0.6240112	1.065378

Hospital Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9869463	0.9610952	1.013493
gender	0.8817919	0.6989092	1.112529
chron_med	2.7820827	0.9802268	7.896115
chron_high	4.3317928	1.6236033	11.557274
income_2	1.2070899	0.7827869	1.861383
income_3	0.9564615	0.6371681	1.435757
income_4	1.0091271	0.6918496	1.471906
income_5	1.0414158	0.7180965	1.510308
urban	1.2284138	0.9309218	1.620975
tot_vsts_low	0.9803081	0.6971333	1.378508
tot_vsts_med	0.9609555	0.6998042	1.319563
coc_low	1.1768114	0.8451394	1.638647
coc_med	1.0161998	0.7531199	1.371179

ii) Second Set of Age Groups

Age 12-19

FP Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9719235	0.9521456	0.9921122
gender	2.0636577	1.8688309	2.2787954
chron_med	1.5045632	1.3563452	1.6689781
chron_high	2.1869224	1.8874625	2.5338939
income_2	0.8919325	0.7440816	1.0691618
income_3	1.0145799	0.8532286	1.2064439
income_4	1.0746820	0.9274761	1.2452520
income_5	0.9894348	0.8673918	1.1286495
urban	1.1877457	1.0562434	1.3356200
tot_vsts_low	0.3605989	0.3173674	0.4097195
tot_vsts_med	0.6612199	0.5749112	0.7604858
coc_low	1.0804369	0.9713651	1.2017560
coc_med	1.2086670	1.0630944	1.3741733

Specialist Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9735682	0.9255550	1.0240721
gender	1.3105480	1.0256863	1.6745238
chron_med	2.9484457	2.2820974	3.8093607
chron_high	7.8754351	5.5186141	11.2387780
income_2	0.7429016	0.4753138	1.1611337
income_3	0.6802492	0.4442309	1.0416633
income_4	0.7548545	0.5256868	1.0839255
income_5	0.7276586	0.5263600	1.0059409
urban	1.1209817	0.8392655	1.4972615
tot_vsts_low	0.2172265	0.1592002	0.2964026
tot_vsts_med	0.5548579	0.3957897	0.7778557
coc_low	1.0004278	0.7695304	1.3006058
coc_med	1.1317586	0.8257391	1.5511892

Total Physician Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9822919	0.9609825	1.0040738
gender	1.8216083	1.6387732	2.0248420
chron_med	1.6501663	1.4773311	1.8432217
chron_high	2.5803424	2.2049582	3.0196341
income_2	0.8975883	0.7398182	1.0890037
income_3	0.9182299	0.7632679	1.1046529
income_4	0.9776012	0.8353660	1.1440544
income_5	0.9137077	0.7939554	1.0515221
urban	1.1486036	1.0134220	1.3018174
tot_vsts_low	0.3769367	0.3288985	0.4319912
tot_vsts_med	0.6928948	0.5967573	0.8045200
coc_low	1.0503777	0.9376619	1.1766430
coc_med	1.1688349	1.0192189	1.3404136

Hospital Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0349891	0.9689859	1.105488
gender	1.0193210	0.7091609	1.465133
chron_med	0.8442848	0.6011530	1.185749
chron_high	1.1865334	0.7944845	1.772044
income_2	1.2528376	0.6902137	2.274082
income_3	1.3269941	0.7650274	2.301765
income_4	1.0239534	0.6125198	1.711750
income_5	1.5424314	0.9499334	2.504486
urban	0.9083762	0.6384874	1.292347
tot_vsts_low	0.9563833	0.6620132	1.381648
tot_vsts_med	1.1865368	0.8065368	1.745574
coc_low	1.3451619	0.9582108	1.888374
coc_med	1.4425381	0.9776658	2.128454

Age 20-44+

FP Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0036844	1.0005868	1.0067916
gender	1.5805454	1.5100610	1.6543198
chron_med	1.4856818	1.4118520	1.5633725
chron_high	2.2671745	2.1399083	2.4020096
income_2	0.8417908	0.7752420	0.9140522
income_3	0.9275661	0.8582250	1.0025097
income_4	0.9729716	0.9103281	1.0399258
income_5	1.0475286	0.9850990	1.1139147
urban	1.1379678	1.0785252	1.2006864
tot_vsts_low	0.3398277	0.3222523	0.3583616
tot_vsts_med	0.5765027	0.5444735	0.6104160
coc_low	0.9756465	0.9280927	1.0256370
coc_med	1.0355173	0.9803193	1.0938233

Specialist Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0440148	1.0367747	1.0513055
gender	2.5572130	2.3069791	2.8345893
chron_med	2.0315141	1.8102879	2.2797753
chron_high	4.3090779	3.7851506	4.9055255
income_2	0.7824988	0.6503951	0.9414344
income_3	0.8103182	0.6806272	0.9647214
income_4	0.8500320	0.7320281	0.9870582
income_5	0.8462606	0.7371000	0.9715872
urban	1.1450241	1.0150692	1.2916164
tot_vsts_low	0.3228264	0.2866084	0.3636213
tot_vsts_med	0.5412441	0.4763944	0.6149214
coc_low	1.0044489	0.8976667	1.1239334
coc_med	1.1120810	0.9835540	1.2574033

Total Physician Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0139360	1.0106477	1.0172350
gender	1.6889228	1.6098726	1.7718546
chron_med	1.5379418	1.4577533	1.6225414
chron_high	2.4392306	2.2955203	2.5919379
income_2	0.8859797	0.8125393	0.9660580
income_3	0.9254205	0.8528572	1.0041576
income_4	0.9506520	0.8864183	1.0195403
income_5	0.9954884	0.9332105	1.0619224
urban	1.1679876	1.1039553	1.2357339
tot_vsts_low	0.3876639	0.3666175	0.4099186
tot_vsts_med	0.6198465	0.5836866	0.6582465
coc_low	0.9859261	0.9354923	1.0390788
coc_med	1.0497566	0.9910207	1.1119736

Hospital Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9990217	0.9861175	1.0120947
gender	1.1132429	0.8989424	1.3786308
chron_med	1.0655565	0.8575516	1.3240144
chron_high	1.2542359	0.9991185	1.5744955
income_2	0.9746095	0.7039082	1.3494140
income_3	1.0531109	0.7760864	1.4290194
income_4	0.7479741	0.5747671	0.9733774
income_5	1.0480497	0.8145239	1.3485280
urban	1.0501318	0.8518361	1.2945881
tot_vsts_low	1.0951506	0.8900749	1.3474763
tot_vsts_med	1.2110265	0.9737012	1.5061963
coc_low	1.0067990	0.8236330	1.2306989
coc_med	0.9564223	0.7725353	1.1840800

Age 45-64

FP Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9981221	0.9941185	1.0021418
gender	1.2258030	1.1721595	1.2819016
chron_med	1.6557958	1.5382097	1.7823705
chron_high	2.4525426	2.2802823	2.6378162
income_2	0.8792992	0.8071364	0.9579138
income_3	0.8976665	0.8271594	0.9741837
income_4	0.9359485	0.8702633	1.0065913
income_5	0.9726740	0.9078768	1.0420959
urban	1.0988476	1.0407560	1.1601816
tot_vsts_low	0.3217160	0.3041838	0.3402586
tot_vsts_med	0.5564940	0.5260750	0.5886720
coc_low	0.8967462	0.8460008	0.9505355
coc_med	0.9551278	0.9006816	1.0128652

Specialist Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0147758	1.0067155	1.0229006
gender	1.9986862	1.8287221	2.1844470
chron_med	1.4935520	1.2892347	1.7302495
chron_high	3.1874186	2.7565647	3.6856155
income_2	0.6732917	0.5680397	0.7980459
income_3	0.7098037	0.6035278	0.8347940
income_4	0.7856621	0.6801618	0.9075266
income_5	0.8205586	0.7157704	0.9406876
urban	1.3255993	1.1901394	1.4764771
tot_vsts_low	0.3587435	0.3209766	0.4009541
tot_vsts_med	0.5445735	0.4871702	0.6087408
coc_low	1.1144514	0.9929099	1.2508707
coc_med	1.1378586	1.0129012	1.2782314

Total Physician Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0088674	1.0045561	1.0131972
gender	1.2737045	1.2143986	1.3359066
chron_med	1.5100441	1.3961798	1.6331944
chron_high	2.4565807	2.2733379	2.6545938
income_2	0.8434063	0.7698552	0.9239843
income_3	0.8661629	0.7938586	0.9450527
income_4	0.9011276	0.8338877	0.9737894
income_5	0.9098788	0.8454152	0.9792579
urban	1.1878810	1.1210848	1.2586572
tot_vsts_low	0.3799576	0.3579365	0.4033336
tot_vsts_med	0.6032149	0.5681310	0.6404654
coc_low	0.9732415	0.9146864	1.0355451
coc_med	1.0106200	0.9493386	1.0758572

Hospital Cost

Variable	Exp(β)	95% Confidence Interval	
age	1.0413619	1.0259884	1.0569657
gender	0.7500611	0.6330057	0.8887624
chron_med	0.9469392	0.6319308	1.4189749
chron_high	1.1036368	0.7543282	1.6147007
income_2	0.8949393	0.6454591	1.2408477
income_3	1.0104923	0.7432824	1.3737642
income_4	0.9939583	0.7486024	1.3197301
income_5	1.0498553	0.7979392	1.3813035
urban	1.1347168	0.9273030	1.3885237
tot_vsts_low	1.1986147	0.9618039	1.4937319
tot_vsts_med	0.9347201	0.7533704	1.1597239
coc_low	1.2628756	1.0078250	1.5824719
coc_med	1.1870651	0.9434514	1.4935836

Age 65-74

FP Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9687102	0.9506439	0.9871197
gender	1.1385059	1.0220768	1.2681980
chron_med	2.0300512	1.5252324	2.7019540
chron_high	3.7829826	2.8822667	4.9651745
income_2	0.6815814	0.5528818	0.8402396
income_3	0.7551822	0.6182465	0.9224478
income_4	0.9813249	0.8196746	1.1748548
income_5	0.9452827	0.7929273	1.1269121
urban	1.0081209	0.8839378	1.1497503
tot_vsts_low	0.3067481	0.2647802	0.3553679
tot_vsts_med	0.5121625	0.4477816	0.5857999
coc_low	0.8533355	0.7308041	0.9964113
coc_med	0.9329954	0.8059558	1.0800598

Specialist Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9721296	0.9417685	1.0034694
gender	0.9413624	0.7848574	1.1290753
chron_med	2.6237797	1.6089849	4.2786107
chron_high	8.2592451	5.1861255	13.1533896
income_2	0.6798524	0.4780510	0.9668409
income_3	0.6919446	0.4941901	0.9688324
income_4	0.8737482	0.6456235	1.1824786
income_5	0.6950471	0.5170417	0.9343356
urban	1.8988177	1.5216881	2.3694138
tot_vsts_low	0.4371269	0.3409214	0.5604807
tot_vsts_med	0.5835443	0.4652550	0.7319083
coc_low	1.2699500	0.9785330	1.6481540
coc_med	1.1793569	0.9215658	1.5092604

Total Physician Cost

Variable	Exp(β)	95% Confidence Interval	
age	0.9716312	0.9518461	0.9918276
gender	1.0191021	0.9057571	1.1466308
chron_med	2.4412077	1.7875550	3.3338806
chron_high	4.9874353	3.7080378	6.7082679
income_2	0.7593585	0.6041398	0.9544567
income_3	0.7491671	0.6020124	0.9322920
income_4	0.9395869	0.7717157	1.1439751
income_5	0.8849720	0.7302398	1.0724907
urban	1.2458751	1.0791098	1.4384123
tot_vsts_low	0.4177046	0.3557169	0.4904944
tot_vsts_med	0.6177097	0.5333518	0.7154100
coc_low	1.0052606	0.8487317	1.1906576
coc_med	1.0689225	0.9108659	1.2544055

Hospital Cost

age	1.0298484	0.9883813	1.073055
gender	0.7153583	0.5638665	0.9075508
chron_med	0.6543821	0.2005871	2.134813
chron_high	1.1759860	0.3822963	3.617464
income_2	1.3614538	0.8584441	2.159205
income_3	1.1032489	0.7099972	1.714314
income_4	1.0798116	0.7143519	1.632239
income_5	0.8458068	0.5728826	1.248754
urban	1.4368095	1.0756940	1.919153
tot_vsts_low	0.6669022	0.4711523	0.9439805
tot_vsts_med	0.7676876	0.5653186	1.042499
coc_low	1.0712048	0.7563205	1.517187
coc_med	1.3320330	0.9633613	1.41793