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Unmet Health Care Needs and Adverse Outcomes for Patients with Chronic Disease

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Unmet Health Care Needs and Adverse Outcomes for Patients with Chronic Disease

by

Paul Everett Ronksley

A THESIS

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Abstract

Chronic medical conditions such as diabetes, hypertension, and heart disease are common in Canada and often occur together. Despite the availability of effective treatments, many Canadians do not receive optimal care for these conditions. This may be due to a number of factors, including reduced access to health services. The overall objective of this thesis was to improve knowledge of barriers to care and their association with adverse outcomes among patients with chronic disease.

We conducted three independent studies to address this objective. Our first study provides a national perspective on the potential gaps in care for Canadians with chronic disease. Using population-based survey data we found that 1 in 7 adults with chronic disease report a perceived unmet health care need – a commonly used indicator of limited access to care. Participants with multiple chronic conditions (multi-morbidity) were more likely to report a barrier to care. Furthermore, the most commonly reported reasons for an unmet need were related to service wait times and resource availability. By linking national survey and administrative data, our second study explored whether these perceived barriers to care were associated with adverse health outcomes. Unmet health care need was not associated with an increased risk of hospitalization when studied in aggregate form. However, when stratified by unmet need type, adults reporting barriers related to resource availability had an increased risk of all-cause hospitalization compared to those without. Our final study examined factors related to health system use and their association with adverse outcomes. Using provincial administrative data, specific patterns of health resource use and discharge disposition were associated with increased risk of subsequent hospitalization after discharge among patients with diabetes.

Despite a universal health care system, gaps in care for patients with chronic medical conditions remain. Although our findings highlight a number of potentially modifiable gaps in chronic disease care, further understanding of the concept of unmet health care need and the various factors that influence it are required. This may inform areas for future intervention aimed at enhancing and improving management for those living with chronic medical conditions.

Preface

The following manuscripts based on work from this thesis have been published or are in press. For both papers, Paul Ronksley was involved in the conceptualization and design of the studies. He was also responsible for drafting the manuscripts, conducting the analysis and interpreting the data with guidance from his thesis committee (Brenda Hemmelgarn, Claudia Sanmartin, Pietro Ravani, and Hude Quan). All authors contributed important intellectual content and provided critical reviews of the papers. Analyses were based on data collected by Statistics Canada. However, the results and interpretations presented in these manuscripts do not represent the opinions of Statistics Canada.

1. **Ronksley PE**, Sanmartin C, Quan H, Ravani P, Tonelli M, Manns B, Hemmelgarn BR.

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2. **Ronksley PE**, Sanmartin C, Quan H, Ravani P, Tonelli M, Manns B, Hemmelgarn BR.

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~ To Vanessa – my best friend, my love – you are a shining light in my life

~ To my family for their constant love and support

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List of Symbols, Abbreviations and Nomenclature

Symbol	Definition
ACCS	Ambulatory Care Classification System
AHCIP	Alberta Health Care Insurance Plan
AKDN	Alberta Kidney Disease Network
AMI	Acute Myocardial Infarction
BMI	Body Mass Index
CCHS	Canadian Community Health Survey
CHF	Congestive Heart Failure
CI	Confidence Interval
CIHI	Canadian Institute for Health Information
COPD	Chronic Obstructive Pulmonary Disease
ED	Emergency Department
eGFR	Estimated Glomerular Filtration Rate
ESRD	End-Stage Renal Disease
HPOI	Health Person-Oriented Information
HR	Hazard Ratio
ICD	International Classification of Diseases
IQR	Inter-quartile Range
OR	Odds Ratio
RR	Rate Ratio
SD	Standard Deviation

Epigraph

Without continual growth and progress, such words as improvement, achievement, and success have no meaning.

~ Benjamin Franklin

CHAPTER 1: INTRODUCTION

1.1 Burden of Chronic Non-Communicable Disease

Obesity, smoking, physical inactivity and an aging population have contributed to a worldwide epidemic of chronic disease¹⁻⁴. In Canada, approximately 1 in 3 adults have 1 or more chronic conditions, including diabetes, hypertension, and heart disease⁵⁻⁹. Not only are these conditions common, they are associated with an increased risk of morbidity and mortality mainly by predisposing to vascular disease, which itself is a major health problem¹⁰⁻¹³.

Given their prevalence and association with adverse outcomes, it is not surprising that the economic and health impact of chronic disease is a major concern in Canada. This high-risk group uses a disproportionate amount of health care resources and the cost associated with their management is estimated to exceed \$40 billion per year¹⁴⁻¹⁶. Although individual diseases dominate health care delivery and medical research, this single disease framework is being challenged by the fact that many of these chronic conditions occur together in patients. Multi-morbidity, that is the co-occurrence of chronic conditions, is now considered the norm rather than the exception, and magnifies the burden placed on the health care system with health resource use and costs increasing with an increase in the number of conditions present^{6, 17-21}.

Though this group represents a relatively small proportion of the total population, they are twice as likely to have a hospitalization compared to those with no chronic disease and account for one quarter of general practice and specialist visits used in Canada⁶. Clearly, chronic disease populations and patients with multi-morbidity are key drivers of health care services use and represent a group that requires further study.

1.2 Barriers to Care for Patients with Chronic Disease

Despite the costs and adverse outcomes associated with these common chronic conditions, there is growing evidence to suggest that disease complications can be reduced and chronic disease care can be improved to ultimately reduce the health and economic burden posed by these conditions²²⁻²⁹. For this reason, identifying more efficient and equitable methods to deliver treatment/care to those with chronic conditions is a major objective in public health.

A coordinated approach to managing these diseases is also necessary to improve the health of individuals living with chronic disease. The Chronic Care Model proposed by Wagner et al. is an example of a multi-pronged approach to chronic disease care that is commonly used in development of programs and in the medical community²⁹. This often includes, but is not limited to disease management programs, the integration of evidence based treatments and guidelines into clinical practice, and patient education efforts aimed at preventing disease progression and improving overall management^{22, 28}. Despite universal health care and the availability of such resources, many Canadians still do not receive the full care required for management of their long-term medical conditions³⁰⁻³⁵. Approximately 1 in 3 Canadians with diabetes reports not having undergone recommended tests for effective diabetes care³⁴, and 1 in 5 adults with hypertension are either unaware of this medical condition or are aware and have not received treatment for blood pressure control³⁵. Lack of care may be related to a number of factors, including limited resource availability, financial barriers, or health behaviors.

Identifying the various factors that prevent or limit a person from receiving the care required, that is, identifying gaps or barriers in care, is important when discussing strategies to optimize

care for chronic disease populations. Furthermore, the elimination of modifiable barriers to care may ultimately improve health outcomes for Canadians with chronic disease. For these strategies to work, we must first understand the factors that influence access to health care and how they interact with one another. We must also know how these different factors place individuals at greater or less risk for adverse outcomes such as hospitalization. For this reason, it is important to base our research within a conceptual framework.

1.3 Access to Care – A Conceptual Framework

The topic of “access” has been at the forefront of health care policy and is also an important political symbol. Despite its importance, most authorities agree that it is a poorly defined term³⁶⁻³⁸. This is due to the multiple meanings given to the term and the fact that access is used synonymously with other terms such as availability of health system resources. There are several frameworks that have been used to help conceptualize the concept of access³⁶⁻⁴¹. Of these, the Aday and Andersen model of access to health care is a foundation from which other frameworks of access have built upon over the past forty years³⁶.

Andersen and colleagues noted that earlier concepts of health services use focused on two dimensions: the characteristics of the population versus the characteristics of the delivery system. They also noted that access could best be measured through outcome indicators, such as service utilization, as an individual passes through the health care system. This was argued to permit external validation of the importance of delivery and population characteristics. However, Andersen realized that when considering the factors that influence the use of health care services, even these characteristics mentioned above are not enough to account for entry or non-entry into

the health care system. The potential consumer's "willingness" to seek care, their attitudes and knowledge about the health system, and level of need must also be considered.

The subsequent framework originally developed by Aday and Andersen in 1974 included five components that interact with each other to conceptualize access to health care. These include health policy, characteristics of the health delivery system, characteristics of the population at risk, utilization of health services, and consumer satisfaction³⁶. Andersen revisited this original model to reemphasize the non-linear nature of access and the role of feedback loops in the system³⁹ (Figure 1.1).

1.4 Unmet Health Care Need

Although researchers and policy makers are interested in understanding factors that influence access to care, there is also a need to identify patients with limited or no access to care. A commonly used measure of limited access to care is through the identification of unmet health care need. Perceived unmet need is a socio-medical indicator commonly used in health services research and is defined as the difference between services judged necessary to deal effectively with health problems and services actually received^{42, 43}. Unmet health needs have been identified as a critical indicator of access-related problems that may result from limited availability or unavailability of health care services when and where they are required. It follows that barriers to care or delays in receiving medical attention could translate into increased morbidity, worsening health status, emergency department (ED) visits, or hospitalization⁴⁴⁻⁴⁶. The identification of unmet needs is particularly important as they can inform public health

policy and areas for future interventions aimed at enhancing and improving management of chronic conditions and ultimately reducing health care costs.

Previous studies have explored perceived unmet health care need and the various factors that influence access within the general population⁴⁷⁻⁵². However, there is limited research in Canada on perceived unmet health care needs amongst patients with chronic medical conditions specifically. Furthermore, assessing the relationship between chronic illness, limited access to care, and adverse outcomes is difficult as conventional data sources rarely gather enough information to comprehensively address these questions on their own.

1.5 Data Sources to Study Access and Unmet Health Care Need

An array of data sources and methods are used to collect and evaluate various aspects of health, including limited access to care. The use of secondary data is an efficient and cost-effective source of data to undertake epidemiologic research. Two common sources that have potential to inform the area of access and perceived unmet health care need among chronic disease populations are survey data and administrative data.

1.5.1 Survey Data

In recent years, there has been growing demand for knowledge of people's perceived morbidity, their use of different health services, and perceived needs for health care. In commissioner Roy Romanow's 2002 report on the Future of Health Care in Canada, he states, "The direction of our health care system must be shaped around the health needs of individual patients, their families and communities"⁵³. This concept of patient-centered care has further emphasized the

importance of surveys to gain insight into aspects of health that can only be obtained by asking people directly. Population based surveys have an advantage over other available secondary sources as they can provide person-level data on a variety of topics including health behaviors, perceived health status, quality of life, and level of satisfaction with the health care system to name a few. However, because of their use of self-report they typically do not contain detailed information about medical histories, and due to their cross-sectional nature, do not provide information on future health outcomes. Furthermore the validity of the information obtained from these surveys is highly dependent on their design and how they are carried out.

Canadian Community Health Survey (CCHS)

The CCHS is a nationally representative cross-sectional survey conducted by Statistics Canada and has been used extensively in health services research^{6, 8, 48, 50, 54}. This survey was introduced in 2000/01 and was conducted every 2 years on over 130,000 Canadians with the overall goal of improving knowledge related to health status, health care utilization, and determinants of health amongst Canadians⁵⁵. The target population of the CCHS is household residents aged 12 years and older in the 10 provinces and 3 territories, but excludes those living on Indian reserves or Crown land, full-time members of the Canadian Forces, institutional residents, and some in remote areas of Canada. Using a multi-stage stratified cluster sampling technique, this survey provides detailed information at the health region level for all provinces and territories of Canada and represents approximately 98% of the Canadian household population.

The CCHS is an ideal data source for studying access to care for a number of reasons. First, it is possible to study perceived unmet health care need and the reasons for limited access to care

through operationalized measures available within this survey. Second, a number of additional factors that influence access, as defined within Andersen and Aday framework, are also commonly available. This includes characteristics of the population at risk (including the three divisions of predisposing, enabling, and need characteristics), utilization of health services, consumer satisfaction, and health behaviors/personal health practices. Third, the presence of chronic disease can be defined through self-reported measures within the CCHS. This is particularly important, as it is possible to generate population-level estimates of limited access to care among chronic disease populations, thus increasing the generalizability of the findings. Finally, the CCHS is a publicly available survey that is easily accessible to researchers. Despite these strengths and the availability of this information, its use for the study of access to care and the association with health care utilization and adverse outcomes in patients with chronic disease has been limited.

1.5.2 Administrative Data

Another common approach to measuring access to care involves assessing utilization of health services. Though it is possible to access self-reported measures of health care use, the validity of these measures is often questioned primarily due to recall bias. An alternative approach is through the use of provincial or national administrative data sources. Administrative data is a collective term used to describe information compiled for the purposes of health system management and provider payment⁵⁶. Once collected for its primary purpose, it can be used to study many aspects of health care, including measures of process and outcomes⁵⁷. It is generally easy to access and process, significantly reduces the cost and time involved in primary data collection, and allows researchers access to population-based data that can be used to answer a

variety of research questions. Administrative data can also provide both cross-sectional and longitudinal information about disease prevalence and incidence for entire populations. Despite its apparent strengths, these sources do not provide insight into the lifestyle, health behaviors, and perceived health care needs of the individual commonly available within survey data. Furthermore, as this data are collected for purposes of provider payment and not for chronic disease research, it is also important to assess their validity for the latter purpose.

The use of administrative data has gained popularity in health services research for a number of reasons mentioned above. With respect to the study of access to care and outcomes in chronic disease populations, a number of national and provincial data sources have the ability to inform this area of research.

Health Person-Oriented Information (HPOI)

The HPOI is a national data holding that captures administrative, clinical, and demographic information on hospital inpatient events. It provides detailed discharge statistics from Canadian health care facilities including admission date, discharge date, length of stay, diagnostic codes, and procedure codes for each patient⁵⁸. Discharge data are received from acute care facilities and select chronic care and rehabilitation facilities across Canadian provinces except Quebec. Discharge data from psychiatric facilities, as well as day procedures (e.g., day surgeries) and emergency department visits are not captured in this database. Within the HPOI, International Classification of Diseases 9th Revision, Clinical Modification (ICD-9-CM) coding was used until 2001/02, following which ICD-10 was implemented.

This data source is a valuable tool for studying access to care as it can be used to chronicle an individual's use of acute care services. Through the use of probabilistic linkage methodology, this data source can also be linked to the CCHS to provide rich and detailed data to answer research questions that neither data source can answer on their own ⁵⁹. Though the HPOI has been linked with the CCHS in prior studies ⁶⁰⁻⁶², it has not been used to study the association between access to care and health outcomes such as hospitalization, mortality, and readmission among chronic disease populations.

The Alberta Kidney Disease Network (AKDN)

The AKDN is a central repository of laboratory data collected across the province of Alberta ⁶³. Laboratory data within the AKDN can be used to define patient populations and provide valuable clinical information including serum creatinine measurements to estimate kidney function as well as HbA1c measurements to estimate blood glucose control in patients with diabetes. Using the unique patient identifier, this repository can be linked to provincial administrative databases including the Alberta Health Insurance Plan (AHCIP) Registry, Alberta vital statistics, Inpatient hospitalization abstracts prepared by Canadian Institute for Health Information (CIHI), Fee for service physician claims data, and the Ambulatory Care Classification System (ACCS) to identify emergency department visits and day procedures.

The administrative data obtained from Alberta Health and housed within the AKDN can also be used to define cohorts with common medical conditions such as hypertension and diabetes. Linkage of data sources also permits assessment of socio-demographic information, clinical variables including co-morbidity and multi-morbidity, as well as system and provider level

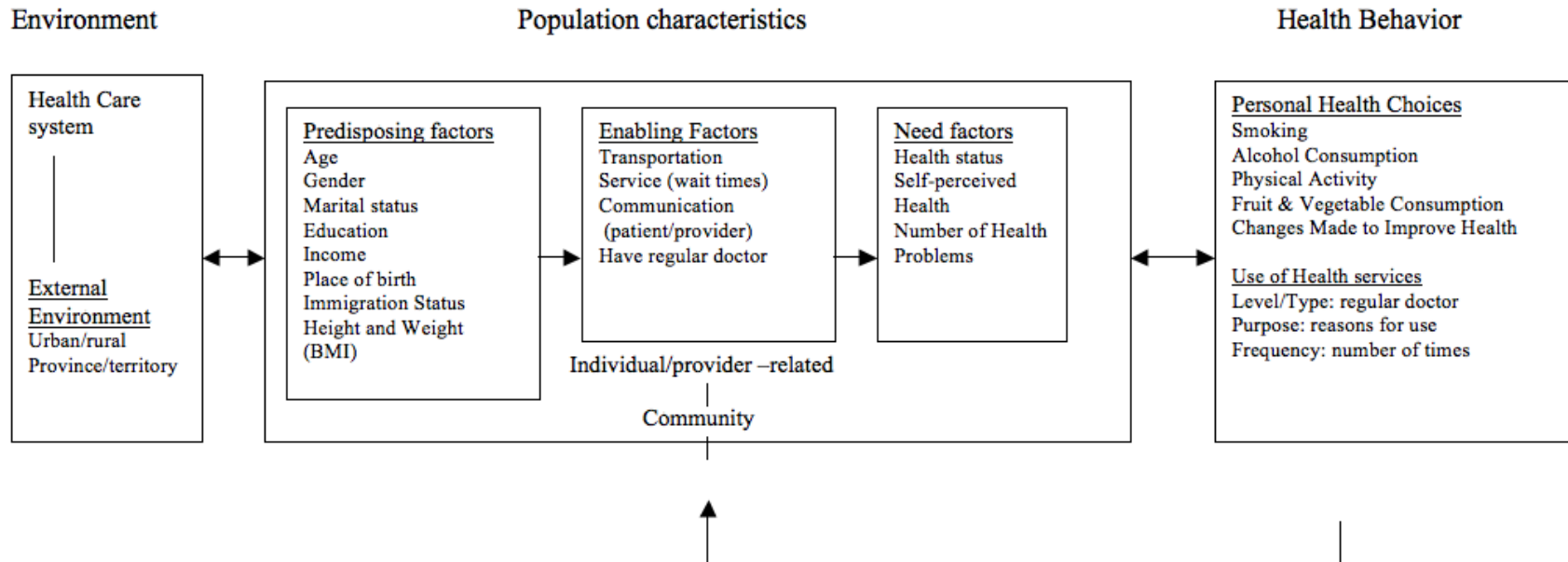
factors that may influence health service use or adverse outcomes. These sources are instrumental in the study of access to care, as it is possible to explore various measures of health system use that may be associated with adverse outcomes such as repeated hospitalization among chronic disease populations.

1.6 Outline of Thesis Contents

This thesis examines the relationships between access to health care and health outcomes among patients with chronic health conditions and draws upon several valuable data sources within Canada and the province of Alberta (described above). Each chapter of this document reports on a unique thesis component formatted for independent publication as part of a paper based thesis. Three common themes are explored throughout the thesis: (1) Access to Care; (2) Multi-morbidity; (3) Health Care Utilization/Adverse Outcomes (Figure 1.2). These themes are linked by the *common objective of improving knowledge of barriers to care and its association with adverse outcomes among patients with chronic medical conditions*. Each chapter represents an independent study distinguished by a specific research question, study cohort, or set of methods. Chapter 2 is comprised of an observational study assessing the association between chronic medical conditions and unmet health care need using population-based survey data. Within this study, we also assess whether this association is modified by the type and number of chronic conditions (multi-morbidity). Chapter 3 extends the results of the first paper and explores the association between unmet health care need and adverse outcomes among chronic disease populations. Linking survey data with national hospitalization records provides a unique opportunity to determine how the various perceived barriers to care experienced by chronic disease patients influence all-cause and cause-specific hospitalization rates, in-hospital mortality,

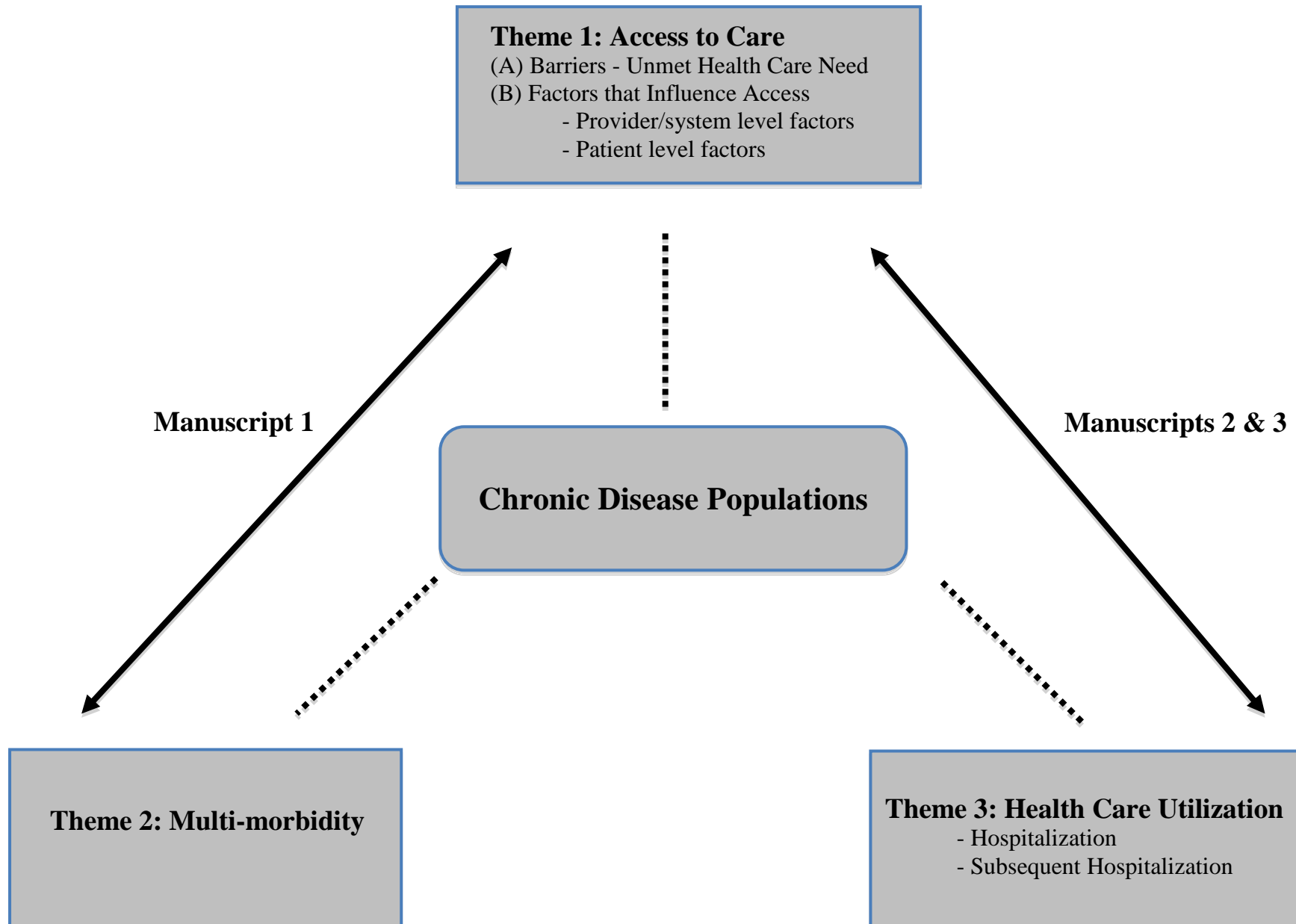
and risk of readmission. Chapter 4 provides further exploration of factors related to health system use associated with adverse outcomes in chronic disease patients. Using provincial administrative data, we examine how patterns of health resource utilization and discharge disposition are associated with the risk of subsequent hospitalization after discharge among patients with diabetes. Finally, Chapter 5 summarizes and synthesizes the findings of the thesis. This concluding chapter discusses the strengths and limitations of the studies, clinical implications, and directions for future research aimed at improving outcomes for patients with chronic disease.

Figure 1.1 Andersen Behavioral Model of Health Care Utilization



Adapted from: R. M. Andersen. "Revisiting the Behavioral Model and Access to Medical care: Does It matter?" J Health Soc Behav 1995;36:1-10

Figure 1.2 Thesis framework



**CHAPTER 2: ASSOCIATION BETWEEN CHRONIC MEDICAL CONDITIONS AND
PERCEIVED UNMET HEALTH CARE NEED**

2.1 Abstract

Background: Although effective treatments exist, many Canadians with chronic medical conditions do not receive the full care they require, possibly as a consequence of limited accessibility or availability. A commonly used indicator of inadequate access to or availability of care is the perception of unmet health care needs. The objective of this study was therefore to determine the association between chronic conditions and perceived unmet health care needs.

Methods: We extracted data for adult respondents from the combined 2001, 2003 and 2005 cross-sectional cycles of the Canadian Community Health Survey. Multivariate logistic regression was used to estimate the association between 7 high-prevalence and –impact chronic conditions (arthritis, chronic obstructive pulmonary disease/emphysema, diabetes, heart disease, hypertension, mood disorder and stroke) and perceived unmet health care needs in the prior 12 months, adjusting for socio-demographic variables, health behaviors, health status and survey cycle.

Results: Of the 360,105 adult respondents, 12.2% reported an unmet health care need. Compared with those without chronic conditions, respondents with at least one condition were more likely to report an unmet need (adjusted odds ratio [OR] 1.51, 95% confidence interval [CI] 1.45–1.59). Those with mood disorders were almost twice as likely to report an unmet need (OR 1.94, 95% CI 1.78–2.12), while those with diabetes or hypertension were less likely to report an unmet need (diabetes OR 0.85, 95% CI 0.76–0.94; hypertension OR 0.96, 95% CI 0.89–1.04). Furthermore, the likelihood of an unmet need increased with the number of chronic conditions (OR 1.71, 95% CI 1.56–1.88 for 3 or more conditions). Respondents with chronic conditions were more likely

than those without to report an unmet need related to resource availability (OR 1.14, 95% CI 1.06–1.22).

Conclusions: Adults with chronic medical conditions are more likely to report an unmet health care need, and the likelihood increases with an increasing number of conditions. Whether these unmet needs are associated with worse outcomes, and whether interventions targeted to address these needs may improve outcomes for Canadians with chronic disease, remain to be determined.

2.2 Introduction

The economic and health impact of chronic medical conditions is a major concern in Canada and abroad ^{4, 6, 9, 14-16}. Approximately 1 in 3 Canadians has 1 or more chronic conditions, including diabetes, hypertension, arthritis and heart disease ^{6, 9, 64}, and the direct cost associated with management of these conditions exceeds \$40 billion annually ¹⁶. Furthermore, people with chronic conditions use a disproportionate amount of health care resources compared with those with no long-term health problems ^{6, 15}. This economic burden is further magnified among subjects with multiple chronic conditions, with health resource use and associated costs increasing with the number of conditions present ⁶⁵.

Consequently, improving care for respondents with chronic disease has become a major focus ^{23, 66-70}. Disease management programs, disease-specific treatments and patient education efforts have been developed to prevent disease progression and to improve management ^{67, 69}. Despite the availability of such resources, many Canadians still do not receive the full care required for management of their long-term medical conditions ^{7, 31, 33-35}. Approximately 1 in 3 Canadians with diabetes reports not having undergone recommended tests for effective diabetes care ³⁴, and 1 in 5 adults with hypertension are either unaware of this medical condition or are aware and have not received treatment for blood pressure control ³⁵. Lack of care may be related to a number of factors, including limited accessibility or other potential barriers to care. It may also be related to personal choice and to expectations of the health care system ⁵¹. Identifying these barriers is important from the standpoint of health services delivery, as eliminating modifiable barriers to care may ultimately improve health outcomes for Canadians with chronic disease.

Preliminary studies have shown that respondents with chronic medical conditions are more likely to report a perceived unmet health care need - a commonly used indicator of inadequate access to care^{48, 50-52, 71}. However, these studies have been limited by a broad definition of chronic disease and have not assessed whether the type or number of chronic conditions have an influence on reported barriers to care⁵⁰. Furthermore, there is limited information on the types of unmet health care needs these populations experience. Given these knowledge gaps, the objectives of this study were to determine whether there is an association between chronic medical conditions and perceived unmet health care needs and, if an association does exist, to determine whether it varies by number and type of chronic conditions present.

2.3 Methods

2.3.1 Study Population

We obtained data from the 2001, 2003 and 2005 cycles of the Canadian Community Health Survey (CCHS), a national cross-sectional survey conducted by Statistics Canada. This survey provides self-reported estimates of health determinants, health status and health care utilization at the health region level. The target population of the CCHS is household residents aged 12 years and older in the 10 provinces and 3 territories, excluding those living on Indian reserves or Crown land, full-time members of the Canadian Forces, institutional residents, and some residents of remote areas of Canada. Details of the survey methodology have been previously published⁷². We limited our study population to adults (18 years of age and older).

2.3.2 Measurement of Exposure – Chronic Disease

Chronic medical conditions, as determined by self-report, were identified from a list of more than 20 different conditions within the CCHS. The 7 chronic medical conditions with the highest prevalence or impact on health care utilization, considered “chronic conditions of interest” by the Health Council of Canada, were identified for study^{14,15}. The conditions were arthritis, chronic obstructive pulmonary disease (COPD) or emphysema, diabetes, heart disease, hypertension, mood disorders and stroke. Survey respondents with none of these 7 conditions were categorized as having no chronic disease, although they might have other chronic conditions defined within the CCHS. We further identified those with multiple chronic conditions by extracting the number of such conditions reported by each respondent.

2.3.3 Measurement of Outcome – Perceived Unmet Health Care Need

Each respondent was asked, “During the past 12 months, was there ever a time when you felt you needed health care but didn’t receive it?” If respondents answered yes to this initial question, they were prompted with a follow-up question: “Thinking of the most recent time, why didn’t you get care?” Reasons for an unmet need were classified into 4 categories: accessibility, availability, acceptability or personal choice, as modified from a previously described classification system developed by Chen and Hou⁴⁸. These categories were established to separate systemic from personal reasons for unmet needs, and to further identify issues related to an individual’s assessment or evaluation of the system (i.e., acceptability) and issues related to personal circumstances and unrelated to the health care system (i.e., choice) (Figure 2.1).

2.3.4 Measurement of Covariates of Interest

Socio-demographic variables and health behaviours were based on the Health Behavior Model proposed by Anderson³⁹, a framework to understand determinants that affect health services use and patient satisfaction. The framework includes predisposing factors, enabling factors, personal health choices, and health care system/environmental factors. With the components of this framework in mind, we considered the following variables: age, sex, marital status, education, household income, immigration status, residency type (urban or rural), aboriginal status, presence of a regular family doctor, perceived health status, body mass index (BMI), smoking and drinking status, and level of physical activity. Definitions for each variable are available on the Statistics Canada website (www.statcan.gc.ca/concepts/health-sante/index-eng.htm).

2.3.5 Statistical Analysis

The proportion of respondents reporting an unmet health care need, and the 4 specific reasons for an unmet need, were compared across number of chronic conditions using χ^2 tests. The type of care required among respondents with an unmet need was also compared across number of chronic conditions. All descriptive statistics were weighted to reflect the Canadian population using sampling weights provided by Statistics Canada. When combining data from different CCHS cycles, we recalculated these sampling weights using an equation provided by Statistics Canada to account for the fact that respondents differed between cycles⁷³. Finally, because of the multistage sampling methodology used in the CCHS surveys, bootstrapping techniques were used to obtain estimates of variance and confidence intervals (CI).

To determine the relationship between chronic disease and unmet health care needs, we used multivariate logistic regression with backward-selection techniques. We identified potential effect modifiers a priori, and interaction terms were developed for the interaction of chronic disease with age and with sex. Model fit was assessed by the likelihood ratio test. Odds ratio (OR) for unmet needs was calculated for respondents with at least one of the chronic diseases compared with those with no chronic disease (reference group), adjusting initially for age and sex only, and subsequently for socio-demographic variables, health behaviors, health status and survey cycle (to account for change over time). Age was categorized as 18–44 years, 45–64 years or ≥ 65 years; BMI was categorized as obese ($\geq 30 \text{ kg/m}^2$) or non-obese ($< 30 \text{ kg/m}^2$). For household income, the “missing” category was included in the model as a separate category because of the large number of respondents with missing data.

Similar models were developed to assess the association between chronic disease and each reason for an unmet need (accessibility, availability, acceptability, personal choice) among respondents reporting an unmet need, as well as between number of chronic conditions (none, 1, 2 or 3 or more) and unmet needs. Because respondents with and without chronic medical conditions vary substantially in terms of demographic variables and health care need, sensitivity analyses were performed using varying reference categories. In the first analysis, the study population was limited to those with chronic conditions. Using respondents with 1 chronic condition as the reference category, we determined the effect of multiple chronic conditions on the odds of reporting an unmet need. A second sensitivity analysis limited the reference group to those with no chronic disease. (As mentioned earlier, “no chronic disease” excludes other chronic diseases defined within the CCHS but not of interest in this study). Finally, subgroup

analyses were performed to determine whether similar associations were observed in hypertensive and diabetic populations.

For all statistical tests, $p < 0.05$ was considered statistically significant. All analyses were conducted at the Prairie Regional Data Centre in Calgary, Alberta, using STATA 11.0 (Statacorp, College Station, Tex.). This study was approved by the ethics review board of the University of Calgary, Calgary, Alberta, and by Statistics Canada.

2.4 Results

A total of 360,105 adult respondents from the 3 CCHS cycles were included in the analysis. The relative proportion of respondents with 1, 2 or 3 or more chronic conditions was 21.3%, 6.8% and 3.6%, respectively (Table 2.1). Respondents with chronic conditions were older were more likely to be female, and had lower household incomes and education levels than those with no chronic conditions. Furthermore, the proportion of respondents with a regular family doctor was higher for adults with chronic conditions and increased with the number of chronic conditions reported. Arthritis and hypertension were the most commonly reported chronic conditions (prevalence 17.8% and 15.5%, respectively), followed by diabetes, heart disease and mood disorders (Table 2.2).

Overall, 12.2% of adult respondents reported an unmet need (Table 2.3). The most commonly reported reason for an unmet need was related to availability (52%), followed by personal choice (32.1%). Generally, the proportion of unmet needs was significantly higher in respondents with chronic medical conditions than in those without and increased with the number of chronic

conditions present (χ^2 and test for trend, $p < 0.001$). Among respondents with 1 chronic condition, 14.0% reported an unmet need. This increased to 16.2% among respondents with 3 or more chronic conditions. There also appeared to be overall trends in the reason for the unmet need. However, these results should be interpreted with caution. Issues related to accessibility increased with the number of chronic conditions, while unmet needs related to personal choice decreased. Finally, among respondents who reported an unmet health care need (n=44,618), 72.8% required care for a physical health problem (types of problems were physical health problem, emotional or mental problem, regular check-up, care of an injury, and other). The proportion of respondents requiring care for physical health problems also increased with the number of chronic conditions (Table 2.4).

2.4.1 Overall Association

Compared with respondents with no chronic disease, the presence of at least 1 chronic condition was associated with an increased likelihood of an unmet need (Table 2.5). In a model adjusted for socio-demographic and health status characteristics, respondents with a chronic condition were 1.5 times more likely to report an unmet need (OR 1.51, 95% CI 1.45–1.59). There was no evidence of effect modification by age or sex. Among respondents reporting an unmet need (n=44,618), presence of 1 or more chronic conditions showed varying associations with the reason for the unmet need. Respondents with chronic disease were more likely to report issues related to availability (OR 1.14, 95% CI 1.06–1.22) and less likely to report barriers to care as a result of personal choice (OR 0.83, 95% CI 0.76–0.90), compared with those with no chronic disease.

2.4.2 Association by Type of Chronic Condition

In analyses by type of condition, arthritis, heart disease and mood disorders were all associated with an increased risk of unmet need (Table 2.6). Respondents with mood disorders were almost twice as likely to report an unmet need (adjusted OR 1.94, 95% CI 1.78–2.12), whereas respondents with diabetes or hypertension were less likely to report an unmet need (OR 0.85, 95% CI 0.76–0.94 and OR 0.96, 95% CI 0.89–1.04, respectively).

2.4.3 Association by Number of Chronic Conditions

Number of chronic conditions also influenced the association between chronic disease and unmet health care needs. Respondents with 1 condition were 1.5 times more likely to report an unmet need (OR 1.50, 95% CI 1.43–1.58) than those with no chronic conditions, whereas respondents with 3 or more conditions were 1.7 times more likely to report an unmet need (OR 1.71, 95% CI 1.56–1.88) (Table 2.7).

2.4.4 Sensitivity Analyses

Analyses restricting the study population to those with chronic disease and using 1 chronic condition only as the reference showed similar results. Although slightly attenuated, the odds of an unmet need were higher among respondents with 2 chronic conditions (adjusted OR 1.11, 95% CI 1.04–1.17) and even higher in those with 3 or more conditions (adjusted OR 1.30, 95% CI 1.18–1.44). When we examined type of need among respondents with reported barriers to care, issues related to availability appeared to increase with the number of chronic conditions present. No trends were observed for need related to accessibility, acceptability or personal choice (Table 2.8).

Our second sensitivity analysis using respondents with no chronic conditions as the reference category strengthened the association between chronic disease and unmet needs (adjusted OR 2.61, 95% CI 2.44–2.78). The odds of an unmet need also increased among respondents with 2 chronic conditions (OR 2.75, 95% CI 2.52–3.01) and with 3 or more conditions (OR 3.21, 95% CI 2.88–3.58).

Similar trends were observed in analyses restricted to those with hypertension (n=68,301) and to those with diabetes (n=22,282). Compared with respondents with hypertension only, respondents with hypertension and 1 other condition were 1.4 times more likely to report an unmet need (OR 1.37, 95% CI 1.22–1.54), whereas respondents with hypertension and 3 or more additional chronic conditions were 2.3 times more likely to report unmet need (OR 2.33, 95% CI 1.92–2.83). Similar trends were observed among the respondents with diabetes (Table 2.9).

2.5 Discussion

Using a large, population-based survey of Canadians, we found that the presence of chronic conditions was associated with an increased risk of perceived unmet health care needs.

Respondents with chronic conditions were 1.5 times more likely to report an unmet need, and the reasons were mainly related to resource availability. Furthermore, this association was influenced by the type and number of chronic medical conditions present among adult respondents.

Our findings complement those from previous studies using population-based survey data^{48, 50-52,}

⁷¹ showing that patients with chronic conditions have a higher proportion of unmet needs than

those without. However, these studies used a broad definition of chronic disease, which included over 20 different conditions, and did not assess the independent effects of specific conditions on the association with unmet needs. A strength of our study was the ability to identify the differential effects of type and number of conditions on the odds of reporting an unmet need, as well as to further explore the association between reasons for unmet needs and type and number of conditions. We found that the proportion of respondents reporting perceived barriers to care changed with the number of reported chronic medical conditions. These novel results suggest there may be a cumulative effect of multiple conditions on reported barriers to care. These results also represent a conservative estimate of this effect, as demonstrated by our sensitivity analyses when we defined the reference group as the absence of chronic conditions.

Chronic care models have emphasized the importance of coordinated care within the health care system and improved self-care for management of chronic disease^{67, 69, 70, 74}. However, multiple conditions often make this task difficult, from both a system and patient perspective^{23, 75, 76}. Bayliss et al. found that patients with multiple chronic conditions often report an overwhelming effect of a single disease condition, which interferes with their ability to appropriately manage other co-morbid conditions⁷⁵. They also found that increased distress from multiple conditions may decrease patients' ability to mobilize health care resources⁷⁷. Given their greater need for coordinated and convenient care, patients with multiple conditions may have higher expectations for health care services, which in turn may explain the higher proportion of respondents with multiple conditions reporting barriers to care. Findings from our restricted analysis support the effect of concordant illnesses on unmet needs. Although diabetes and hypertension were not independently associated with barriers to care, the odds of an unmet need increased when these

conditions were assessed in combination with others. Given that diabetes and hypertension represent 2 common conditions that often co-exist, these results highlight the complexity of co-morbidity in primary care. These results also echo the body of literature suggesting a differential effect of concordant versus discordant illnesses on perceived barriers to care^{78, 79}.

The most commonly reported reason for an unmet need was related to service availability, confirming results of previous studies⁴⁸⁻⁵⁰. Although improving availability of care and decreasing service wait times continue to top the Canadian health care agenda, future work must determine whether disparities related to availability are associated with worse outcomes in populations with chronic disease, and whether interventions targeted to address these needs ultimately improve outcomes. The fact that respondents with chronic medical conditions are more likely to have a family doctor than those with no chronic conditions suggests that the issue is not access to primary health care, but rather the quality or quantity of care they are receiving. Our analysis of the type of care required supports this claim. Not surprisingly, we found that the proportion of care related to physical health problems increased in the presence of multiple chronic conditions. Kasman has proposed that lengthy wait times to see specialists may explain why barriers related to availability increase with number of chronic diseases⁷¹. This conclusion is further supported by results from the International Health Policy Survey of Sicker Adults, which shows that respondents with chronic disease experience longer wait times for specialist appointments in Canada than in 7 other countries⁸⁰.

Furthermore, when considering disease type, respondents with mood disorders and arthritis had an increased likelihood of an unmet health care need, while those with diabetes and hypertension

did not. This may be related to the symptomatic nature of arthritis and mood disorders, resulting in a perceived unmet need. It has been suggested that, because there are fewer treatment options for conditions involving pain and subjective symptoms, treatment may fail to meet the patient's expectations for symptomatic and functional changes, leading to frustration and negative attitudes toward the health care system^{71, 81}.

Our study should be interpreted in light of its limitations. First, variables for exposure and outcome were obtained from self-reported survey data, and thus, there are issues related to their reliability and validity. Second, potential barriers to care were defined using one question in the CCHS about unmet needs, which respondents may have interpreted various ways. Specifically, a negative response might indicate that the respondent felt he or she had no need for health care, or that he or she needed care but endured a lengthy wait for care^{52, 71}. Despite this limitation, we have no reason to believe interpretation of this question would differ by type of chronic condition. Third, with respect to the reasons for reporting an unmet need, understanding the differential associations between the type of chronic condition and the reason for unmet need is important from a policy perspective. Interestingly, we found that respondents with chronic conditions were less likely to report an unmet need related to personal choice. Exploring whether this association is related to self-management, disease severity or attitudes towards the health care system remains an important area for future research. Finally, we limited our definition of chronic disease to the 7 most highly prevalent, high-impact chronic medical conditions, which may affect the generalizability of these findings. Given the differential impact we observed among the 7 selected conditions included in our study, further work is required to determine whether other chronic conditions or disease severity negatively affect access to care.

In summary, our study provides a national perspective on the potential gaps in care for Canadians with chronic disease. With the use of a large population-based sample, we demonstrate that adults with chronic conditions, and in particular those with multiple conditions are more likely to report a perceived barrier to care. Given the increasing prevalence of chronic disease in the population, future studies should focus on clarifying the types of unmet health care needs these groups experience as well as the impact of these unmet needs on health outcomes and on future requirements for more acute care services. These results represent important first steps to ultimately improve management and health outcomes for the millions of Canadians living with chronic disease.

Table 2.1 Respondent characteristics

Characteristics	Number of chronic conditions, n (%)					<i>p</i> value†
	Total (360,105) (100)	None (217,350) (60.4)	1* (85,424) (23.7)	2 (38,539) (10.7)	≥ 3 (18,792) (5.2)	
Male, %	49.0	51.4	45.3	42.0	43.5	<0.001
Age, %						
18-44 years	51.6	66.6	28.6	10.4	4.3	
45-64 years	32.6	27.4	45.2	41.1	35.2	<0.001
≥ 65 years	15.8	6.0	26.3	48.5	60.6	
Rural Resident, %	18.1	17.3	19.7	20.1	20.2	<0.001
Household Income, %						
- <\$50,000	9.0	9.0	9.3	8.6	8.2	
- \$50-60,000	8.8	9.2	8.4	7.6	6.2	<0.001
- \$60-80,000	14.6	16.0	13.3	10.1	7.7	
- >\$80,000	25.7	29.5	21.6	13.3	7.9	
- Missing	41.9	36.4	47.3	60.3	70.1	
Marital Status, %						
- Married / Common-law	64.5	63.2	68.6	65.7	60.8	
- Single	22.6	28.3	13.2	7.9	6.5	<0.001
- Other	12.9	8.5	18.2	26.4	32.7	
Level of Education, %						
- Less than high school	19.6	14.0	25.9	37.7	45.3	
- High school graduate	18.9	19.6	18.3	16.9	14.6	<0.001
- Some post secondary	8.7	9.8	7.1	5.7	5.4	
- Post secondary graduate	52.8	56.6	48.8	39.7	34.6	
Obese (BMI ≥ 30), %	15.2	11.5	19.2	27.6	33.3	<0.001
Born outside of Canada, %	22.7	22.5	22.7	24.3	23.6	0.009
Aboriginal Status, %	2.3	2.2	2.5	2.3	2.6	0.002
Regular Family Doctor, %	85.1	80.9	92.3	96.1	97.1	<0.001

Self-perceived Health, %						
- Excellent	22.9	29.8	12.2	4.0	1.4	
- Very Good / Good	64.9	65.3	70.0	60.2	38.1	<0.001
- Fair / Poor	12.2	4.9	17.8	35.8	60.5	
Smoking Status, %						
- Current	24.9	26.2	24.3	19.2	17.0	
- Former	41.1	37.9	45.7	49.9	54.7	<0.001
- Never	34.0	35.9	30.1	30.9	28.3	
Drinking Status, %						
- Regular / Occasional	81.0	84.3	78.6	69.3	59.3	
- Former	12.1	9.1	14.8	21.7	30.2	<0.001
- Never	6.9	6.6	6.6	9.0	10.5	
Physical Activity Level, %						
- Active	23.3	25.4	21.2	15.8	12.1	
- Moderate	24.7	25.2	24.6	22.6	18.9	<0.001
- Inactive	52.1	49.4	54.2	61.6	69.0	

* Chronic conditions include: arthritis, chronic obstructive pulmonary disease/emphysema, diabetes, heart disease, hypertension, mood disorder, stroke.

† p value for comparison of respondents with no chronic disease, 1, 2 or ≥ 3 conditions (χ^2)

**Table 2.2 Proportion (%) of respondents with selected chronic medical conditions
(n=360,105)**

Chronic Medical Condition	Proportion
Arthritis	17.8
COPD / Emphysema	1.4
Diabetes	5.0
Heart Disease	5.4
Hypertension	15.5
Mood Disorder	5.8
Stroke	1.2

Table 2.3 Proportion of respondents with self-perceived unmet health care needs by number of chronic medical conditions

Characteristic	Number of chronic conditions, n (%)					<i>p</i> value*
	Total	None	1	2	≥ 3	
	360,105 (100)	217,350 (60.4)	85,424 (23.7)	38,539 (10.7)	18,792 (5.2)	
% with unmet need	12.2	11.2	14.0	13.6	16.2	< 0.001
Reason for unmet need†						
Accessibility, %	11.7	10.8	12.3	13.9	14.4	< 0.001
Availability, %	52.0	50.0	53.9	58.0	55.7	< 0.001
Acceptability, %	5.8	5.7	6.0	6.2	5.5	< 0.001
Personal choice, %	32.1	35.3	28.5	24.5	25.1	< 0.001

* *p* value for comparison of respondents with no chronic disease, 1, 2 or ≥ 3 conditions (χ^2)

† Among respondents reporting an unmet health care need

Table 2.4 Type of care required by number of chronic medical conditions among respondents reporting an unmet health care need (n=44,618)

Number of chronic conditions	Total (44,618)	None (24,886)	1 (11,547)	2 (5,167)	≥ 3 (3,018)	<i>p</i> value*
Type of care required:						
Treatment of a physical health problem, %	72.8	72.1	72.9	75.1	78.1	<0.001
Treatment of an emotional or mental health problem, %	8.7	7.2	11.3	11.3	10.0	<0.001
A regular check-up, %	8.3	9.6	6.6	5.6	5.5	<0.001
Care of an injury, %	7.7	8.6	7.3	5.6	3.4	<0.001
Other, %	7.6	7.4	7.5	8.1	9.4	<0.001

* *p* value for comparison of respondents with no chronic disease, 1, 2 or ≥ 3 conditions (χ^2)

Table 2.5 Odds of an unmet health care need by presence (versus absence) of chronic condition

	Unadjusted OR (95% CI)	Age-Sex Adjusted OR (95% CI)	Multivariate Adjusted† OR (95% CI)
Chronic Disease present*	1.31 (1.27–1.35)	1.88 (1.81–1.95)	1.51 (1.45–1.59)
<i>Type of Unmet Need</i> (n=44,618)			
- Accessibility	1.22 (1.12–1.34)	1.26 (1.14–1.40)	1.04 (0.92–1.17)
- Availability	1.23 (1.16–1.30)	1.10 (1.03–1.17)	1.14 (1.06–1.22)
- Acceptability	1.06 (0.94–1.19)	1.06 (0.92–1.21)	1.15 (0.99–1.32)
- Personal Choice	0.68 (0.66–0.71)	0.79 (0.73–0.86)	0.83 (0.76–0.90)

* At least one highly prevalent/high-impact chronic condition (arthritis, chronic obstructive pulmonary disease/emphysema, diabetes, heart disease, hypertension, mood disorder, stroke).
Note: Reference group is respondents with no self-reported chronic medical conditions of interest

† Multivariate model adjusted for age, sex, household income, level of education, marital status, having a regular family doctor, self-perceived health status, aboriginal status, immigration status, and survey cycle

Table 2.6 Odds of an unmet health care need for selected chronic conditions

	Unadjusted OR (95% CI)	Age-Sex Adjusted OR (95% CI)	Multivariate Adjusted* OR (95% CI)
Arthritis	1.44 (1.39–1.49)	1.98 (1.90–2.06)	1.51 (1.41–1.61)
COPD / Emphysema	1.57 (1.40–1.77)	2.06 (1.83–2.32)	1.19 (0.99–1.43)
Diabetes	0.96 (0.90–1.02)	1.24 (1.16–1.33)	0.85 (0.76–0.94)
Heart Disease	1.17 (1.10–1.24)	1.75 (1.64–1.87)	1.16 (1.04–1.30)
Hypertension	0.91 (0.87–0.95)	1.20 (1.15–1.26)	0.96 (0.89–1.04)
Mood Disorder	2.89 (2.71–3.07)	2.76 (2.59–2.94)	1.94 (1.78–2.12)
Stroke	1.29 (1.16–1.44)	1.86 (1.66–2.08)	1.16 (0.96–1.40)

*Multivariate model adjusted for age, sex, household income, level of education, marital status, having a regular family doctor, self-perceived health status, aboriginal status, immigration status, and presence of each co-morbid condition

Table 2.7 Odds of an unmet health care need by number of chronic conditions present

Number of chronic conditions*	Unadjusted OR (95% CI)	Age-Sex Adjusted OR (95% CI)	Multivariate Adjusted† OR (95% CI)
No chronic disease	Reference	Reference	Reference
1 condition	1.29 (1.25–1.34)	1.73 (1.66–1.80)	1.50 (1.43–1.58)
2 conditions	1.25 (1.20–1.32)	2.16 (2.04–2.28)	1.52 (1.41–1.62)
≥ 3 conditions	1.54 (1.44–1.65)	3.06 (2.89–3.30)	1.71 (1.56–1.88)

*Chronic conditions include arthritis, chronic obstructive pulmonary disease/emphysema, diabetes, heart disease, hypertension, mood disorder, and stroke. Note: Reference group is respondents with no self-reported chronic medical conditions of interest.

†Multivariate model adjusted for age, sex, household income, level of education, marital status, having a regular family doctor, self-perceived health status, aboriginal status, immigration status, and survey cycle

Table 2.8 Type of need by number of chronic medical conditions amongst respondents reporting an unmet health care need (n=44,618)

	Unadjusted OR (95% CI)	Age-Sex Adjusted OR (95% CI)	Multivariate Adjusted† OR (95% CI)
Accessibility:			
- None	Reference	Reference	Reference
- 1 condition*	1.16 (1.04–1.29)	1.19 (1.06–1.34)	1.06 (0.93–1.22)
- 2 conditions	1.33 (1.15–1.54)	1.42 (1.21–1.67)	1.02 (0.85–1.22)
- ≥ 3 conditions	1.39 (1.17–1.65)	1.52 (1.25–1.86)	1.05 (0.83–1.33)
Availability:			
- None	Reference	Reference	Reference
- 1 condition	1.17 (1.09–1.25)	1.08 (1.01–1.15)	1.10 (1.02–1.18)
- 2 conditions	1.38 (1.26–1.51)	1.20 (1.08–1.33)	1.26 (1.13–1.41)
- ≥ 3 conditions	1.25 (1.11–1.42)	1.07 (0.93–1.23)	1.17 (1.00–1.35)
Acceptability:			
- None	Reference	Reference	Reference
- 1 condition	1.06 (0.93–1.21)	1.06 (0.91–1.22)	1.06 (0.91–1.24)
- 2 conditions	1.10 (0.89–1.35)	1.09 (0.87–1.37)	1.05 (0.83–1.34)
- ≥ 3 conditions	0.97 (0.77–1.21)	0.97 (0.73–1.27)	0.89 (0.67–1.18)
Personal Choice:			
- None	Reference	Reference	Reference
- 1 condition	0.82 (0.75–0.89)	0.82 (0.75–0.89)	0.86 (0.79–0.94)
- 2 conditions	0.72 (0.65–0.81)	0.72 (0.65–0.81)	0.81 (0.71–0.91)
- ≥ 3 conditions	0.78 (0.65–0.91)	0.78 (0.67–0.91)	0.89 (0.76–1.05)

*Chronic conditions include arthritis, chronic obstructive pulmonary disease/emphysema, diabetes, heart disease, hypertension, mood disorder, and stroke.

†Multivariate model adjusted for age, sex, household income, level of education, marital status, having a regular family doctor, self-perceived health status, aboriginal status, immigration status, and survey cycle

Table 2.9 Odds of an unmet health care need by number of additional chronic conditions present amongst respondents with hypertension or diabetes

	Unadjusted OR (95% CI)	Age-Sex Adjusted OR (95% CI)	Multivariate Adjusted* OR (95% CI)
(n=68,301)			
Hypertension only	Reference	Reference	Reference
Hypertension + 1	1.26 (1.15–1.38)	1.60 (1.45–1.76)	1.37 (1.22–1.54)
Hypertension + 2	1.58 (1.41–1.76)	2.23 (1.99–2.51)	1.52 (1.32–1.75)
Hypertension + 3 or more conditions	2.49 (2.13–2.91)	3.67 (3.12–4.33)	2.33 (1.92–2.83)
(n=22,282)			
Diabetes only	Reference	Reference	Reference
Diabetes + 1	1.13 (0.95–1.34)	1.43 (1.19–1.70)	1.15 (0.94–1.41)
Diabetes + 2	1.41 (1.18–1.68)	2.11 (1.74–2.55)	1.48 (1.19–1.84)
Diabetes + 3 or more conditions	2.34 (1.90–2.87)	3.65 (2.92–4.56)	2.39 (1.83–3.13)

Chronic conditions include arthritis, chronic obstructive pulmonary disease/emphysema, diabetes, heart disease, hypertension, mood disorder, and stroke.

*Multivariate model adjusted for age, sex, household income, level of education, marital status, having a regular family doctor, self-perceived health status, aboriginal status, and survey cycle

Figure 2.1 Categorization of types of unmet need

Type of Unmet Need
Accessibility (barriers that restrict the entry into or use of health care resources) <ul style="list-style-type: none">- Cost- Transportation
Availability (reflect perceived deficiencies in health care delivery that inhibit a persons ability to receive care) <ul style="list-style-type: none">- Waiting time too long- Not available when requested- Not available in area
Acceptability (personal attributes and attitudes related to the health care system) <ul style="list-style-type: none">- Dislike doctor/Afraid- Language problems- Didn't know where to go
Personal Choice (concerns attitudes and competing responsibilities not related to the health care system) <ul style="list-style-type: none">- Too busy- Didn't get around to it/Didn't bother- Felt it would be inadequate- Decided not to seek care- Personal/Family responsibilities

**CHAPTER 3: ASSOCIATION BETWEEN PERCEIVED UNMET HEALTH CARE
NEED AND RISK OF ADVERSE HEALTH OUTCOMES AMONG PATIENTS WITH
CHRONIC MEDICAL CONDITIONS**

3.1 Abstract

Background: Adults with chronic medical conditions are more likely to report unmet health care need. Whether unmet health care need is associated with an increased risk of adverse health outcomes is unclear.

Methods: Adults with ≥ 1 self-reported chronic condition (arthritis, COPD, diabetes, heart disease, hypertension, mood disorder, stroke) from the 2001 and 2003 Canadian Community Health Survey cycles were linked to national hospitalization data. Participants were followed from the date of their survey until March 31, 2005 for the primary outcomes of all-cause and cause-specific hospitalization. Secondary outcomes included length of stay, 30-day and 1-year all-cause readmission to hospital, and in-hospital mortality. Negative binomial regression models were used to estimate the association between unmet health care need, hospitalization, and length of stay, adjusting for socio-demographic variables, health behaviors, and health status. Logistic regression was used to estimate the association between unmet need, readmission, and in-hospital mortality. Further analyses were conducted by type of unmet need.

Results: Of the 51,932 adults with chronic disease, 15.5% reported an unmet health care need. Participants with unmet health care need had a similar risk of all-cause hospitalization (adjusted rate ratio [RR] 1.04, 95% CI 0.94–1.15) compared to those with no unmet need. When stratified by type of need, participants that reported issues of limited resource availability had a slightly higher risk of hospitalization (RR 1.18, 95% CI 1.09–1.28). There was no association between unmet need and length of stay, readmission, or in-hospital mortality.

Conclusions: Overall, unmet health care needs were not associated with an increased risk of inpatient hospitalizations among those with chronic conditions. However, certain types of unmet needs may be associated with higher or lower risk. Whether unmet needs are associated with other measures of resource use remains to be determined.

3.2 Introduction

Approximately 1 in 3 Canadians have one or more chronic diseases including diabetes, hypertension, arthritis, and heart disease^{6, 9, 14, 15} and the direct cost associated with management of these conditions in Canada exceeds \$40 billion/yr¹⁶. Consequently, improving care for patients with chronic disease has become a major focus^{66, 68-70}. Despite multidisciplinary care programs, many Canadians do not receive adequate care for management of their chronic medical conditions^{30, 32, 34}. Patients with chronic medical conditions, and in particular those with multiple conditions, are more likely to report a perceived unmet health care need – a commonly used indicator of inadequate access to care⁸².

Perceived unmet health care need is often defined as a need for health care that remains because appropriate health care was not received⁴⁷. It is conceivable that an unmet need may result in delays in receiving medical attention and, in turn, result in worse health outcomes⁴⁷. If this is true, then determining the association between unmet health care need and adverse outcomes is important from a health services delivery standpoint, as recognition and elimination of these potentially modifiable barriers to care may improve health outcomes. However, the evidence relating unmet need, health care utilization, and health outcomes is limited and inconsistent.

Previous work has shown that unmet needs are associated with higher rates of emergency department visits^{83, 84} while other studies have found equivocal changes in rates of hospitalization and general physician visits in the general population⁴⁷. Studies employing other commonly used measures of inadequate access to care have also found that patients who self-reported delayed health care or difficulties in accessing medical services had higher rates of

hospitalizations and longer length of stay^{44, 46} while others have shown no differences in adverse outcomes including mortality and functional decline⁸⁵. These discrepant results may be due to differences in study population, issues of recall bias, and self-reported measures of health care utilization. Few studies have addressed the effect of unmet need and outcomes in a high-risk population of patients with chronic disease. Further, the majority of studies could not determine if there are differential effects of unmet need type on health outcomes. To address these limitations we used Canadian population-based data to determine the association between unmet health care need and risk of hospitalization among adults with chronic disease. We also sought to determine if unmet health care needs were associated with features of the hospitalization including length of stay, readmission, and in-hospital mortality. We hypothesized that the presence of an unmet need would result in a higher risk of outcomes compared to chronic disease groups with no unmet need.

3.3 Methods

3.3.1 Study Population

We obtained data from the 2001 and 2003 cycles of the Canadian Community Health Survey (CCHS) linked to the national hospitalization file (the Health Person-Oriented Information file) from April 1, 1997 to March 31, 2005. The CCHS is a national survey conducted by Statistics Canada that provides self-reported estimates of health determinants, health status and health care utilization at the health region level. The target population of the CCHS is household residents aged 12 years and older in the 10 provinces and 3 territories, excluding those living on Indian reserves or Crown land, full-time members of the Canadian Forces, institutional residents, and some residents of remote areas of Canada⁷². The national hospitalization file captures

administrative, clinical, and demographic information on hospitalizations and provides detailed discharge statistics from Canadian health care facilities including admission and discharge date, length of stay, in-hospital mortality, as well as diagnostic and procedure codes for each patient. Discharge data are received from acute care facilities and select chronic care and rehabilitation facilities across Canadian provinces except Quebec⁵⁸. Within the hospitalization file, International Classification of Diseases – 9th Revision, Clinical Modification (ICD-9-CM) coding is used for diagnostic and procedure codes until 2001/02, following which ICD-10 was implemented.

Survey and hospitalization data were linked at the individual level using an established probabilistic linkage methodology based on unique identifying information including health insurance number, postal code, date of birth, and age⁶⁰. Linkage was conducted for all CCHS respondents living outside Quebec who provided consent to link their survey data to other sources of health information. Within this linked data source, we identified adults (≥ 18 yrs) with at least one self-reported chronic medical condition (arthritis, chronic obstructive pulmonary disease (COPD) or emphysema, diabetes, heart disease, hypertension, mood disorders, and stroke) as defined within the CCHS. The Health Council of Canada has recognized these seven chronic conditions of interest as those with the highest prevalence or impact on health care utilization^{14, 15}.

3.3.2 Measurement of Exposure - Perceived Unmet Health Care Need

The exposure of interest was self-reported unmet health care needs identified within the CCHS. Each respondent was asked, “During the past 12 months, was there ever a time when you felt

you needed health care but didn't receive it?" If respondents answered yes to this initial question, they were prompted with a follow-up question: "Thinking of the most recent time, why didn't you get care?" Reasons for an unmet need were classified into 4 categories: accessibility, availability, acceptability, or personal choice, modified from a classification system developed by Chen and Hou⁴⁸. These categories were established to separate personal from health-care system related reasons for unmet needs, and to further identify issues related to an individual's assessment or evaluation of the system (i.e., acceptability) from those related to personal circumstances and unrelated to the health care system (i.e., choice) (Figure 3.1).

3.3.3 Measurement of Outcomes – All-cause and Cause-specific Hospitalization

The primary outcomes of interest were all-cause and cause-specific hospitalizations identified within the hospitalization file. The study period was defined by the date of participation in the CCHS for each respondent, with follow-up to March 31, 2005 (the last date for which hospitalization data was available). For all-cause hospitalization, we assessed the number (count) of hospitalizations excluding pregnancy-related events. Given that a number of chronic conditions used to define our study cohort commonly occur together and are associated with vascular-related morbidity^{10, 12, 13}, cause-specific hospitalizations for acute myocardial infarction (AMI), congestive heart failure (CHF) and stroke were identified using pre-specified ICD-9-CM and ICD-10 codes within the most responsible diagnosis field (Table 3.1). Secondary outcomes included in-hospital length of stay (defined as the count of in-hospital days for all admissions following participation in the CCHS survey), 30-day and 1-year all-cause readmission to hospital (identified between the first and second hospitalizations following CCHS participation) and in-hospital mortality within any hospitalization.

3.3.4 Measurement of Covariates of Interest

Socio-demographic variables and health behaviors were based on the Health Behavior Model proposed by Anderson³⁹, a framework to understand determinants that affect health services use and patient satisfaction. The framework includes predisposing factors, enabling factors, personal health choices, and health care system/environmental factors. With the components of this framework in mind, we considered the following variables as potential confounders: age, sex, marital status, education, household income, immigration status, residency type (urban or rural), aboriginal status, presence of a regular family doctor, perceived health status, body mass index (BMI), smoking and drinking status, and level of physical activity (definitions available at www.statcan.gc.ca/concepts/health-sante/index-eng.htm)

3.3.5 Statistical Analysis

We described respondents' socio-demographic information and health behaviors using proportions, which were compared across unmet health care need status using chi-squared tests (χ^2). All descriptive statistics were weighted to reflect the Canadian population using sampling weights provided by Statistics Canada. Due to the multistage sampling methodology used in the CCHS surveys, bootstrapping techniques were used to obtain estimates of variance and confidence intervals (CI).

To determine the relationship between unmet health care needs and risk of all-cause hospitalization, we used multivariate zero-inflated negative binomial regression with backward elimination techniques. This regression analysis addresses the excess of zero counts (participants with no hospitalizations) as well as the potential for over-dispersion observed within the

distribution of hospital events as compared to the Poisson distribution. We identified potential effect modifiers a priori, and interaction terms were developed for unmet need by age and unmet need by sex. Model fit was assessed by the likelihood ratio test. Rate Ratios (RRs) were calculated for respondents with an unmet health care need compared to those without (reference group), adjusted for socio-demographic variables, health behaviors, health status, and survey cycle (to account for change across time). Age was categorized as (18-44 yrs, 45-64 yrs, ≥ 65 yrs) and BMI was categorized into obese ($\text{BMI} \geq 30 \text{ kg/m}^2$) and non-obese ($< 30 \text{ kg/m}^2$). For household income, “missing” was included as a separate category due to the large number of respondents with missing data for this variable. Similar models were developed to determine whether the association between unmet health care need and all-cause hospitalization differed by the type of unmet need reported (accessibility, availability, acceptability, personal choice).

The association between unmet need and cause-specific hospitalizations for AMI, CHF, and stroke among respondents with chronic disease was also assessed. Recognizing that associations with barriers to care and cause-specific hospital outcomes may differ by type of chronic disease, a sensitivity analysis was also performed among participants with self-reported vascular-related chronic conditions specifically (hypertension, diabetes, heart disease, and stroke). A number of additional sensitivity analyses were performed on our primary outcome. Given the possibility that an unmet health care need might impact chronic disease patients in a more immediate fashion, we aimed to assess the influence of follow-up time on all-cause hospitalization by limiting study follow-up to 1 year after participation in the CCHS survey. Secondly, individuals with multiple chronic conditions are more likely to report an unmet need⁸². Additional analyses

were therefore performed to determine the influence of number of chronic conditions on all-cause hospitalization.

For the secondary outcomes (length of stay, all-cause readmission to hospital within 30 days or 1 year, and in-hospital mortality), we limited the cohort to chronic disease participants with at least one hospitalization. To determine the relationship between unmet health care need and length of stay, multivariate negative binomial regression modeling was performed. Multivariate logistic regression was used to model the odds of readmission to hospital and in-hospital mortality by unmet health care need status. Model development and assessment was similar to that described for the primary outcomes. For all statistical tests, $p < 0.05$ was considered statistically significant. All analyses were conducted at the Prairie Regional Data Centre in Calgary, Alberta using STATA 11.0 (Statacorp, College Station, TX). This study was approved by the Ethics Review Board of the University of Calgary and Statistics Canada.

3.4 Results

A total of 51,932 adult respondents with at least one chronic medical condition were included in the cohort, of whom 15.5% reported an unmet need in the previous year. Participants with an unmet need were younger, more likely to be female, had higher levels of education, and were more likely to be obese compared to those with no reported unmet needs. Furthermore, the proportion of respondents with a regular family doctor was lower among those with a reported unmet need (Table 3.2). Amongst participants with a reported unmet need ($n=7,897$), the most commonly reported unmet need related to availability (50.4%) and personal choice (35.8%). The proportion of participants reporting an unmet need also varied by type and number of chronic

conditions present (Table 3.3). Specifically, participants with mood disorders were most likely to report an unmet need (25.6%) where as individuals with hypertension and diabetes were less likely (10.8% and 12.2% respectively). Generally, the proportion of unmet need increased with number of chronic conditions. Among respondents with 1 chronic condition, 15.3% reported an unmet need. This increased to 17.9% among respondents with 3 or more chronic conditions.

3.4.1 Association Between Unmet Need and All-cause Hospitalization

The mean follow-up time for participants was 3.0 years (standard deviation: 1.1 years). During this study period 21,166 participants experienced 47,075 all-cause hospitalizations. Compared to respondents without an unmet need, there was no increased risk of all-cause hospitalization for respondents with an unmet need (Adjusted RR 1.04, 95% CI 0.94–1.15) (Figure 3.2). There was no evidence of effect modification by age ($p = 0.61$) or sex ($p = 0.12$). When stratified by type of unmet need we found that subjects reporting an unmet need related to availability of resources had a slightly increased risk of hospitalization compared to those with no unmet need (Adjusted RR 1.18, 95% CI 1.09–1.28). Subjects reporting unmet need related to acceptability had no difference in the risk of hospitalization compared to those with no unmet need (Adjusted RR 0.85, 95% CI 0.71–1.02). We found that participants reporting need related to availability tended to be older, were more likely to live in rural areas, and had higher levels of education and income compared to participants reporting other types of unmet need (accessibility, acceptability, and personal choice).

3.4.2 Association Between Unmet Need and Cause-specific Hospitalization

Compared to participants with no unmet need, participants with unmet needs were less likely to be hospitalized for AMI (RR 0.63, 95% CI 0.43–0.94) and stroke (RR 0.63, 95% CI 0.49–0.85). No differences were observed in the risk of CHF-related hospitalizations (RR 0.88, 95% CI 0.62–1.26) (Figure 3.3).

3.4.3 Sensitivity Analyses

Sensitivity analyses limiting the study cohort to participants with vascular-related chronic conditions (n=14,618) did not change the observed association between unmet need and all-cause hospitalization (RR 1.07, 95% CI 0.91–1.26). However, the association between unmet need and cause-specific hospitalization for AMI and CHF were reversed and non-significant (AMI (RR 1.05, 95% CI 0.70–1.56); CHF (RR 1.20, 95% CI 0.63–2.26)). The association between unmet need and cause-specific hospitalization for stroke was attenuated and non-significant (RR 0.57, 95% CI 0.32–1.03).

Limiting study follow-up to a one-year period after participation in the CCHS survey resulted in a similar risk of all-cause hospitalization among participants with and without an unmet need (Adjusted RR 0.98, 95% CI 0.81–1.19). Similarly, individual models assessing the association between unmet need and all-cause hospitalization by number of chronic conditions found no association (1 condition: (Adjusted RR 0.98, 95% CI 0.86–1.12); 2 conditions: (RR 1.18, 95% CI 0.98–1.39); 3 or more conditions: (RR 0.96, 95% CI 0.84–1.09)).

3.4.4 Association Between Unmet Need and Length of Stay, Readmission, and In-hospital Mortality

Amongst subjects with at least one hospitalization, we found no differences in length of stay among participants with unmet needs compared to those without (Adjusted RR 0.97, 95% CI 0.85–1.10) or in the risk of 30-day or 1-year readmission to hospital (Table 3.4). Similarly, there was no association between unmet needs and in-hospital mortality (Adjusted OR 0.82, 95% CI 0.62–1.09).

3.5 Discussion

Using a large population-based survey linked to national hospitalization records, we found no association between perceived unmet health care needs and risk of inpatient hospitalization (all-cause or cause-specific) among participants with chronic disease. Only among adults reporting unmet needs related to resource availability was there a slight increased risk of all-cause hospitalization, compared to those with no unmet needs. There was no association between unmet health care needs and features of the hospitalization including length of stay, hospital readmission or in-hospital mortality.

Previous studies using the CCHS have found that unmet needs are associated with increased health care resource use, including increased general physician visits and emergency department visits^{47, 83, 84}. Though few studies have explored the association between unmet needs and hospitalizations specifically, it has been suggested that respondents with an unmet need also have more hospitalizations compared to those with no unmet need⁴⁷. However, these findings were statistically non-significant and based on self-reported measures of health care use. A strength of

our study was the ability to measure the outcomes of interest within national administrative data, eliminating concerns of recall bias that may be present in prior studies.

In relation to other commonly used measures of limited access to care, our findings contrast previous work which suggests that limited access or delays in seeking care may result in increased risk of hospitalization and longer lengths of stay^{44, 46}. Bindman et al explored the association between self-reported access to care and risk of hospitalization in California, and reported that individuals with poor perceived access to medical care (5-point scale that asked respondents how difficult it was for them to get health care) had higher rates of hospitalization for chronic diseases compared to those with no access difficulties⁴⁴. Similarly, Weissman et al observed that patients who self-reported a delay in receiving medical attention had hospital stays that were 9% longer compared to patients with no reported delays⁴⁶. Though these studies suggest a potential association between limited access to care and hospital related outcomes, both were cross-sectional in nature and could not determine if the perceived barriers to care preceded the outcomes of interest. In our study the prospective design eliminated issues of temporality. A prior study also employing a prospective design found no association between self-reported delays in care and health outcomes. Specifically, Rupper and colleagues showed that delays in seeking medical attention did not increase the risk of mortality or functional decline in a population of community dwelling elderly subjects⁸⁵. They concluded that additional work is needed to explore the process of seeking health care and to better understand the current measures of limited access to care that are used in health research.

An interesting finding that warrants further exploration was the differential effect of the type of unmet need and risk of all-cause hospitalization. We found a small but statistically significant increased risk of all-cause hospitalization among participants with an unmet need related to availability (lengthy wait times and unavailable services) but not for other types of need including accessibility, acceptability or personal choice. Although not statistically significant, a prior study suggested a trend to increased risk of hospitalization for patients with an unmet need related to wait times and limited resource availability⁴⁷. Though it is difficult to determine the exact mechanism behind this association, we speculate that not receiving timely care may result in additional care requirements at a later date. Regardless, these findings highlight the need for a disaggregated approach to the study of unmet need in future studies and suggest that specific types of unmet needs may put chronic disease patients at greater risk for adverse outcomes.

We found that participants with chronic disease and an unmet need were less likely to have cause-specific hospitalizations for AMI and stroke. This may in part be a result of the chronic conditions used to define our study cohort. Reasons for hospitalization may be different for patients with symptomatic chronic conditions with unmet needs (arthritic, COPD, mood disorders) compared to those with vascular-related chronic conditions (diabetes, hypertension, heart disease, stroke). Furthermore, this association was attenuated and non-significant when we limited our cohort to participants with vascular-related chronic conditions.

Our overall results of no association between unmet needs and risk of hospitalization, readmission or mortality can be interpreted in a number of ways. First, it may be an indication that our health care system, with universal access, is adequate to meet the needs of individuals

with chronic disease. Despite 16% of adults with chronic disease reporting an unmet need, these unmet needs did not translate into an increased risk of inpatient hospitalization and related events. Second, it may be that patients with unmet needs are accessing other aspects of the health care system to maintain their health status and avoid hospitalization. Specifically, unmet needs have been associated with increased emergency department visits⁸⁴ and visits to general practitioners in emergency departments as opposed to primary care settings⁸³. Finally it is also possible that our current measures of limited access to care are non-specific and cannot discriminate between those at risk for adverse outcomes from those that are not. The need for future work to better understand the meaning of an “unmet need” and how patients interpret these questions in the setting of health surveys has been emphasized⁵².

Our results should be interpreted in light of its limitations. First, our exposure of interest was obtained from self-reported survey data and measured at one point in time. As a result, we could not determine if an unmet need reported at the beginning of the study was sustained throughout follow-up or represented a short-term need that was resolved. Though it is possible that our relatively long follow-up time may be one reason for the null findings as the impact of an unmet need might be more immediately realized in this population, results were similar in our sensitivity analysis limiting follow-up to one year. Future studies should consider the use of a time-varying covariate to measure the effect of unmet needs over time. However, given the constant need for care amongst patients with chronic disease, and in particular those with multiple chronic conditions, it is likely that a perceived unmet need would be sustained throughout follow-up. Secondly, our study cohort was also based on self-reported data and may be an underestimation of the true prevalence of chronic disease in the population. This cohort

was also heterogeneous and contained a number of different chronic conditions. Given that unmet health care need varied by the type of chronic condition, it is possible that differential associations by disease type may potentially explain the null finding between unmet need and all-cause hospitalization. Unfortunately, we could not adequately model these associations with our study sample. Thirdly, social and behavioral risk factors such as BMI and smoking status may have changed during the study period. Given that these covariates were also measured at a single point in time, we are unable to determine their influence on our study findings. Further, there is the possibility of residual confounding, as we could not adjust for chronic disease severity or duration – two variables that may affect the potential association in question. We did however adjust for self-perceived health status and a number of other relevant covariates using the Health Behavior Model proposed by Anderson³⁹ and feel that any unmeasured variables would need to be very strong to influence our findings. Finally, we did not capture outpatient deaths and were unable to account for this as a potential competing risk in our analysis. However the number of deaths outside of hospitals is likely to be low and similar across unmet need status.

Despite these limitations, our study has a number of strengths. Our ability to link national survey data with national hospitalization records provides a unique opportunity to comprehensively assess the effect of unmet health care need on health care utilization and outcomes in chronic disease populations. The use of a prospective cohort design also ensured that our exposure preceded the outcomes of interest and allowed us to account for differential follow-up times amongst study participants. Finally, the use of a population-based cohort of adults (≥ 18 yrs) with at least one high impact chronic condition increases the generalizability of the study results. This is particularly important given the growing burden of chronic disease in Canada and abroad.

In summary, our study provides a national perspective on the association between unmet health care need and hospital outcomes among adults with chronic medical conditions, and indicates that adults with chronic conditions and self-perceived unmet needs do not experience an increased risk of hospital-specific outcomes. The small increased risk for the subgroup with an unmet need defined by limited resource availability may suggest a high-risk group in which unmet need result in poor health outcomes. Future work should focus on identifying these groups as well as exploring other measure of health care utilization that may better reflect the impact of self-perceived unmet need.

Table 3.1 ICD-9-CM and ICD-10 codes for identifying cause-specific hospitalizations

Cause-specific event	ICD-9-CM Codes	ICD-10 Codes
Acute Myocardial Infarction	410	I21.x, I22.x
Congestive Heart Failure	428.x	I50.x
Stroke	325.x, 362.3, 430.x, 431.x, 433.x1, 434.x1, 435.x, 436, 437.6	H34.1, I60.x, I61.x, I63.x, I64.x, I67.7, G08, G45.x (excluding G45.4)

Table 3.2 Respondent characteristics

Variables	All* (n=51,932)	Unmet Needs (n=7,897)	No Unmet Needs (n=44,035)	<i>p</i> value†
Male (%)	43.0	36.9	44.1	<0.001
Age, yrs (%)				
18-44 yrs	28.3	44.2	25.4	
45-64 yrs	40.0	38.5	40.3	<0.001
65+ yrs	31.7	17.2	34.3	
Rural Resident (%)	20.0	19.4	20.1	0.285
Household Income (%)				
- <\$50,000	9.9	10.0	9.9	
- \$50-60,000	8.9	8.4	9.0	
- \$60-80,000	13.7	13.2	13.8	0.209
- >\$80,000	19.8	19.0	20.0	
- Missing	47.6	49.4	47.3	
Marital Status (%)				
- Married / Common-law	66.3	59.9	67.5	
- Single	13.1	19.8	11.8	<0.001
- Widowed/Separated/ Divorced	20.6	20.3	20.7	
Level of Education (%)				
- Less than high school	27.6	23.3	28.4	
- High school graduate	19.3	18.3	19.5	<0.001
- Some post secondary	8.0	10.8	7.5	
- Post secondary graduate	45.1	47.7	44.6	
Obese (BMI ≥ 30) (%)	21.7	23.6	21.4	0.010
Born outside of Canada (%)	23.6	19.4	24.4	<0.001
Aboriginal Status (%)	2.3	3.6	2.1	<0.001
Have a Regular Family Doctor (%)	94.1	88.6	95.1	<0.001

Self-perceived Health (%)				
- Excellent	11.2	7.4	11.9	
- Very Good / Good	63.6	56.2	65.0	<0.001
- Fair / Poor	25.2	36.4	23.1	
Smoking Status (%)				
- Current	24.5	35.4	22.5	
- Former	46.8	40.1	48.0	<0.001
- Never	28.7	24.5	29.5	
Drinking Status (%)				
- Regular / Occasional	76.1	78.3	75.8	
- Former	17.4	16.9	17.4	<0.001
- Never	6.5	4.8	6.8	
Physical Activity Level (%)				
- Active	19.8	18.6	20.0	
- Moderate	24.0	23.1	24.2	0.062
- Inactive	56.2	58.3	55.8	

* Among patients with at least one chronic condition of interest (arthritis, COPD, diabetes, heart disease, hypertension, mood disorder, stroke)

† p value for comparison of respondents by unmet need status (χ^2)

Table 3.3 Proportion of subjects reporting an unmet health care need by type and number of chronic medical conditions

Chronic Medical Condition	Proportion with unmet need (%)*
Arthritis (n=28,025)	16.0
COPD / Emphysema (n=1,667)	17.6
Diabetes (n=6,943)	12.2
Heart Disease (n=8,315)	14.2
Hypertension (n=21,570)	10.8
Mood Disorder (n=13,133)	25.6
Stroke (n=1,690)	13.7
Number of Chronic Medical Conditions	
1 (n=33,515)	15.3
2 (n=12,675)	14.9
≥ 3 (n=5,742)	17.9

* Proportions weighted to represent Canadian household population.

Table 3.4 Associations between unmet health care needs, length of stay, readmission to hospital, and in-hospital mortality (amongst participants with at least one hospitalization n=21,166)

	Length of Stay in Hospital (days), Median (IQR)	Unadjusted Model RR (95% CI)	Multivariate Adjusted Model† RR (95% CI)
No unmet need (n=17,824)	7 (3-17)	Reference	Reference
Unmet need (n=3,342)	5 (2-15)	0.95 (0.81-1.10)	0.97 (0.85-1.10)
	30-day Readmission to Hospital, n (%)*	Unadjusted Model OR (95% CI)	Multivariate Adjusted Model†† OR (95% CI)
No unmet need (n=17,824)	1,612 (9.0)	Reference	Reference
Unmet need (n=3,342)	295 (8.8)	0.97 (0.79-1.20)	0.99 (0.79-1.25)
	1-Year Readmission to Hospital, n (%)*	Unadjusted Model OR (95% CI)	Multivariate Adjusted Model†† OR (95% CI)
No unmet need (n=17,824)	5,537 (31.1)	Reference	Reference
Unmet need (n=3,342)	979 (29.3)	0.92 (0.81-1.05)	0.95 (0.82-1.10)
	In-Hospital Mortality, n (%)*	Unadjusted Model OR (95% CI)	Multivariate Adjusted Model†† OR (95% CI)
No unmet need (n=17,824)	1397 (7.8)	Reference	Reference
Unmet need (n=3,342)	166 (5.0)	0.62 (0.47-0.81)	0.82 (0.62-1.09)

* Proportions weighted to represent Canadian household population.

† Multivariate negative binomial regression model adjusted for age, sex, obesity, household income, level of education, marital status, having a regular family doctor, self-perceived health status, aboriginal status, and survey cycle.

†† Multivariate logistic regression models adjusted for similar variables above.

Figure 3.1 Categorization of types of unmet need**Type of Unmet Need****Accessibility (barriers that restrict the entry into or use of health care resources)**

- Cost
- Transportation

Availability (reflect perceived deficiencies in health care delivery that inhibit a persons ability to receive care)

- Waiting time too long
- Not available when requested
- Not available in area

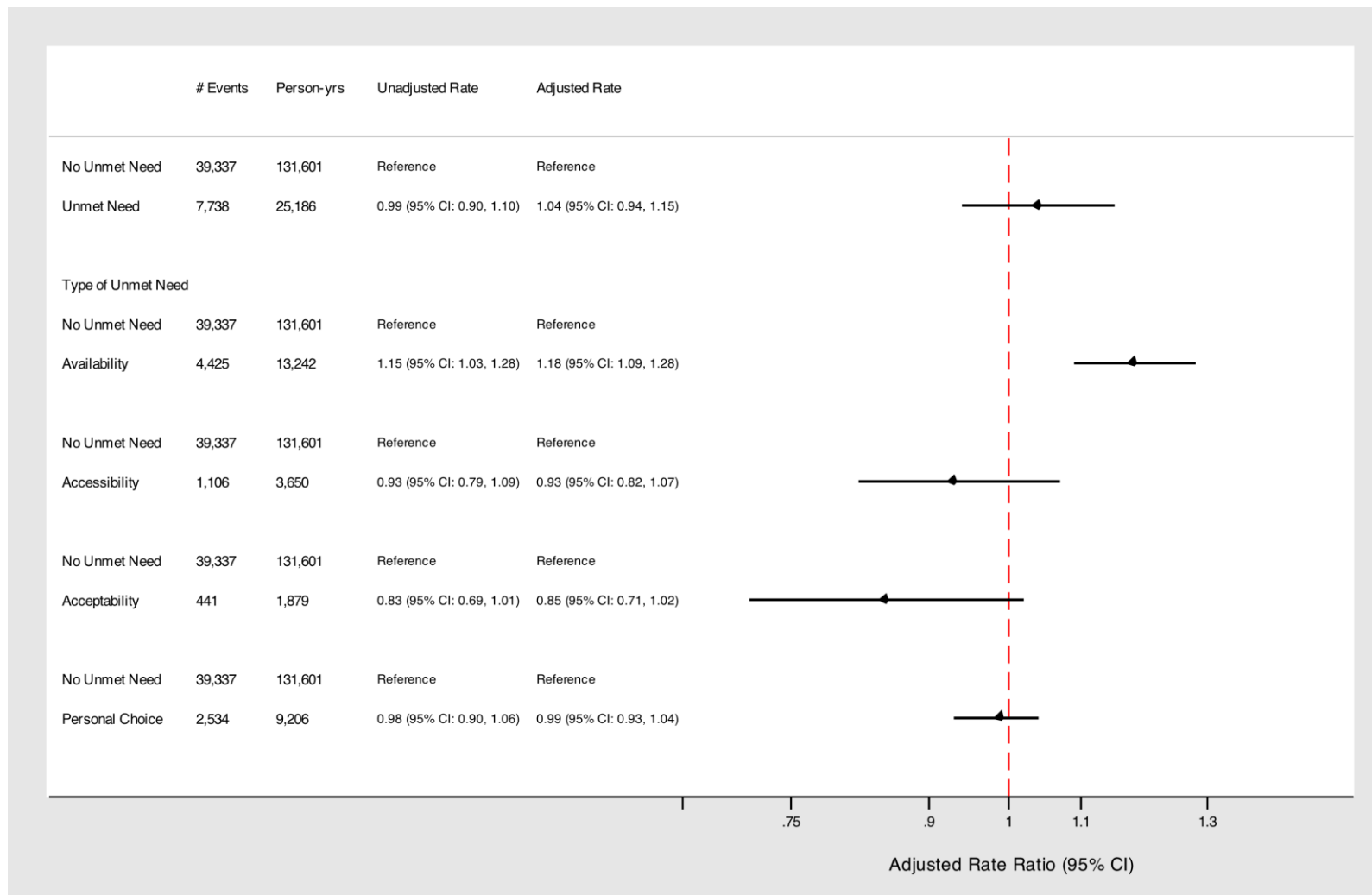
Acceptability (personal attributes and attitudes related to the health care system)

- Dislike doctor/Afraid
- Language problems
- Didn't know where to go

Personal Choice (concerns attitudes and competing responsibilities not related to the health care system)

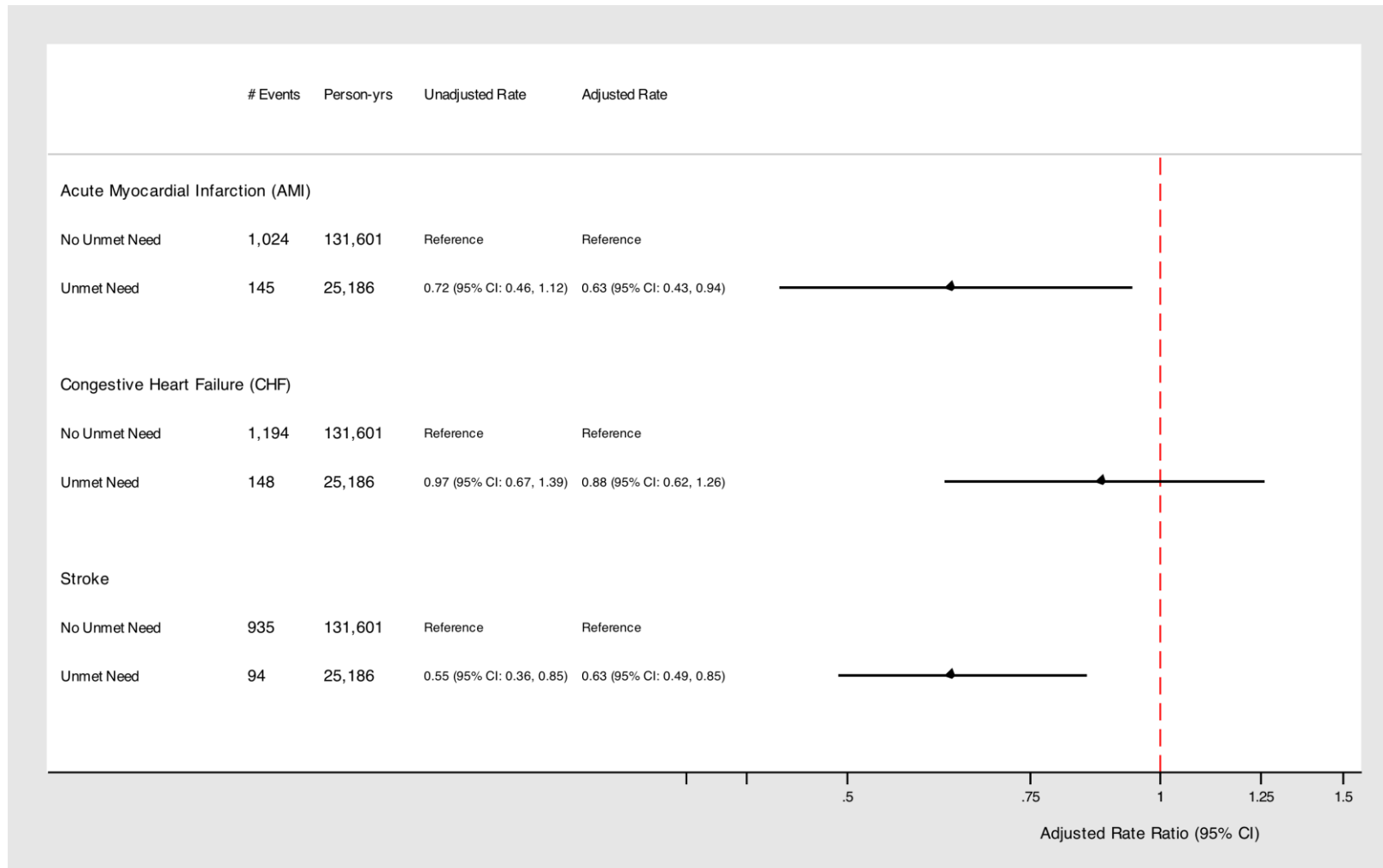
- Too busy
 - Didn't get around to it/Didn't bother
 - Felt it would be inadequate
 - Decided not to seek care
 - Personal/Family responsibilities
-

Figure 3.2 Association between unmet health care need and *all-cause* hospitalization (stratified by type of unmet need)



Multivariate zero-inflated negative binomial regression models adjusted for age, sex, obesity, household income, level of education, marital status, having a regular family doctor, self-perceived health status, aboriginal status, and survey cycle.

Figure 3.3 Association between unmet health care need and *cause-specific* hospitalization



Multivariate zero-inflated negative binomial regression models adjusted for age, sex, obesity, household income, level of education, marital status, having a regular family doctor, self-perceived health status, aboriginal status, and survey cycle.

**CHAPTER 4: ASSOCIATION BETWEEN HEALTH SYSTEM USE AND
SUBSEQUENT HOSPITALIZATION AMONGST PATIENTS WITH DIABETES**

4.1 Abstract

Background: Hospitalization related to patient level factors (age and co-morbidity) is common among patients with diabetes. We sought to determine the association between factors related to health system use (health care resource utilization and discharge disposition) and risk of subsequent hospitalization within one year of discharge for patients with diabetes.

Methods: We identified adults with incident diabetes in Alberta, Canada, who had at least one hospitalization between January 1, 2004 and March 31, 2011, following their diabetes diagnosis. We followed patients from the date of discharge of their index hospitalization for the primary outcome of a subsequent hospitalization within one year. We censored patients if they were event free at one year, or died within one year of follow-up. We used Cox regression to estimate the association between factors related to health system use (including prior emergency department use, primary care physician visits, and discharge disposition) and the risk of subsequent all-cause hospitalization adjusting for socio-demographic variables, co-morbidities, and factors related to the index hospitalization. Secondary outcomes were time to cardiovascular and diabetes-specific subsequent hospitalization.

Results: Of the 33,811 adults with diabetes and at least one hospitalization, 11,095 patients experienced a subsequent all-cause hospitalization. Compared to patients with no emergency department visits, there was a 4 percent increased risk of a subsequent all-cause hospitalization for every additional emergency department visit (adjusted Hazard Ratio [HR] 1.04, 95% CI 1.03–1.05). Both limited and increased use of primary care were associated with increased risk of a subsequent hospitalization. Finally, compared to patients discharged home, patients

discharged against medical advice were more likely to have a subsequent all-cause hospitalization (adjusted HR 1.74, 95% CI 1.50–2.02) and were almost 3 times more likely to have a diabetes-specific subsequent event (adjusted HR 2.86, 95% CI 1.82–4.49).

Conclusions: Patterns of health system use and disposition following hospital discharge are associated with an increased risk of subsequent hospitalization among patients with diabetes. Whether these patterns of health system use are due to limited access to community-based care for patients with diabetes, placing them at higher risk of a subsequent hospitalization, remains to be determined. A better understanding of the circumstances surrounding discharge against medical advice is also needed amongst this high-risk group.

4.2 Introduction

Diabetes is a major public health concern both internationally and nationally. In Canada, approximately one in ten adults has diabetes ^{5, 86} with costs associated with treatment estimated to exceed \$12 billion dollars per year in 2010 ⁸⁷. A large component of this spending is attributed to the direct costs of inpatient care, despite the fact that diabetes is a chronic condition generally amenable to treatment in the outpatient setting ^{64, 88, 89}. Previous work has shown that patients with diabetes have an increased risk of hospitalization compared to those without diabetes ⁹⁰⁻⁹³. A limited number of studies also suggest that repeated hospitalizations are common and, although observed in a smaller proportion of patients with diabetes, may represent a disproportionate burden on the health care system ⁹⁴⁻⁹⁸.

Identifying factors that contribute to subsequent hospitalization among patients with diabetes is therefore important from a health services delivery standpoint. Given the multi-factorial nature of this issue, the Andersen Behavioral Model for health care utilization can be used as a framework to identify the various patient and provider/system level factors that may influence this outcome ³⁹. Prior studies have identified patient level factors that place patients with diabetes at greater risk for a subsequent hospitalization including demographic (age, sex, race, and socioeconomic status), clinical (co-morbidity, diabetes duration), and behavioral factors (glycemic control, and adherence to medication) ⁹⁴⁻⁹⁹. However, many of these studies are restricted to pediatric or elderly patients with diabetes limiting the generalizability of their findings. Furthermore, few studies have assessed additional aspects of patient care including the availability and use of health resources on the risk of subsequent hospitalization. This includes resource utilization and the destination of patients following discharge from hospital.

These characteristics, related to health system use, represent two potentially modifiable factors related to patient need and the health systems response to this need. Identifying whether these factors are associated with risk of subsequent hospitalization may inform future program change to improve care for patients with diabetes as well as the development of interventions aimed at reducing costs associated with inpatient hospitalization in this high-risk group. Given the limitations in previous research and the burden that repeated hospitalization places on the health care system, we used population-based provincial administrative data to determine the association between factors related to health system use (health resource utilization and discharge disposition), and the risk of subsequent hospitalization among patients with diabetes.

4.3 Methods

4.3.1 Study Population

We identified all adults (≥ 18 years) with incident diabetes and at least one hospitalization following diabetes diagnosis in the province of Alberta, Canada between January 1, 2004 and March 31, 2011. Eligible participants with diabetes were identified using an administrative data derived validated algorithm (two physician claims or one hospital discharge code for diabetes within a two-year period)¹⁰⁰. The date in which the algorithm was met was defined as the participants' diabetes diagnosis date. We then identified the first (index) hospitalization, excluding pregnancy-related events, from the date of diabetes diagnosis until March 31, 2011. Subjects treated with dialysis or a kidney transplant prior to the index event, as determined from provincial renal program databases were excluded¹⁰¹, as they are a unique subgroup with high rates of hospitalization^{102, 103}. Participants that died in hospital were also excluded. This study

cohort was derived from a previously described provincial laboratory repository - the Alberta Kidney Disease Network (AKDN) ⁶³.

4.3.2 Measurement of Health System Use

We defined factors related to health system use from the administrative data files of the provincial health ministry (Alberta Health), including the number of emergency department visits and primary care physician visits in the year prior to the index hospitalization and the discharge disposition of the index event. We treated emergency department visits as a discrete continuous variable from 0 up to 1 visit per week (52 events per year). Outpatient primary care physician visits were categorized based on the count distribution into 0 visits, 1-4 visits, 5-9 visits, ≥ 10 visits per year. Discharge disposition was also treated as a categorical variable using the International Classification of Diseases, Tenth Revision (ICD-10) coding scheme within the hospital discharge abstracts database, and included transfer to a palliative care setting, transfer to a long-term care facility, discharged home, discharged home with support services, or discharged against medical advice.

4.3.3 Measurement of Outcomes

We followed participants for a maximum of one year from discharge from their index hospitalization until a subsequent hospitalization, death, out-migration, or end of study follow up (March 31, 2011), whichever came first. The primary outcome was subsequent hospitalization, defined as an all-cause hospitalization (excluding pregnancy-related hospitalizations) within 1 year of discharge from an index (all-cause) hospitalization. Secondary outcomes included time to subsequent hospitalization for cardiovascular (acute myocardial infarction (AMI), congestive

heart failure (CHF), stroke) and diabetes-specific outcomes irrespective of the diagnosis from the index hospitalization. Cardiovascular outcomes were identified using validated administrative algorithms¹⁰⁴⁻¹⁰⁶ and diabetes-specific hospitalizations were identified using pre-specified ICD-10 codes within the most responsible diagnosis field (Table 4.1).

4.3.4 Measurement of Covariates

We identified covariates of interest based on the Andersen Behavioral Model³⁹. Patient-level characteristics included age, sex, urban/rural status, First Nations Status, neighborhood median household income quintile, and diabetes duration. Co-morbidities included hypertension, affective disorder, and conditions defined within the Charlson co-morbidity index¹⁰⁷. We identified hypertension from hospital discharge records and physician claims based on validated algorithms¹⁰⁸. Affective disorder was defined as at least two physician claims or 1 hospitalization coding for affective disorder in a 3-year period prior to the index hospitalization. Additional co-morbid conditions from the Charlson co-morbidity index were identified using validated ICD-10 coding algorithms¹⁰⁹ and the presence of 1 or more diagnostic code in any position up to 3 years prior to the index hospitalization. Using provincial laboratory data sources, we determined whether a participant had at least one A1c measurement in the 6-month period prior to their index hospitalization. We also identified the most recent serum creatinine measurement in the same time period to estimate the kidney function (estimated glomerular filtration rate [eGFR]) using the CKD-EPI equation¹¹⁰. eGFR was categorized as ≥ 90 , 89.9 to 60, 45 to 59.9, 30 to 44.9, 15 to 29.9, and < 15 mL/min/1.73 m². Characteristics related to the index hospitalization included length of stay, hospitalization type (emergent/urgent or elective), and the most responsible diagnosis of the index event (categorized based on ICD-10 chapters).

4.3.5 Statistical Analysis

Participant characteristics were described using proportions, means (standard deviation (SD)), and medians (inter-quartile range (IQR)) where appropriate. We used Cox proportional hazards regression to study the association of health resource use, discharge disposition, and time to subsequent all-cause hospitalization. Initially, unadjusted hazard ratios (HRs) were calculated for all health resource use/discharge disposition variables of interest. We compared the hazard of subsequent hospitalization by the number of primary care physician visits in the year prior to their index hospitalization (0 visits, 5-9 visits, ≥ 10 visits per year) compared to those with 1-4 visits per year. The hazard of subsequent hospitalization by discharge disposition was also compared against those discharged home (reference group). Emergency department visits in the year prior to the index hospitalization was modeled as a continuous variable.

We developed multivariate models based on the identification of significant predictors of subsequent hospitalization. Using a stepwise model building approach, we added the following groups of variables separately into an adjusted model: socio-demographic variables, co-morbidities, and factors related to the index hospitalization. For the neighborhood median household income quintile and level of kidney function (eGFR) variables, “missing” was included as a separate category due to the number of respondents with missing data for these variables. Finally, we used backwards elimination techniques to develop reduced models based on the presence or absence of effect modification and confounding by the specified predictors. Variables were retained based on their potential confounding effect ($\geq 10\%$ change of the exposure coefficients) or if they had a significant independent effect on outcomes. Our analysis was repeated for the outcomes of time to subsequent hospitalization for cardiovascular and

diabetes-specific causes. The proportional hazard assumption was evaluated and satisfied for all bivariate and multivariable adjusted survival analyses. Model fit was also assessed graphically using standard methods.

We conducted a number of sensitivity analyses to assess the robustness of our study findings. First, to ensure that all patients had sufficient time to experience the outcome of interest, we limited our cohort to those with at least one year of follow-up from discharge of their index event until March 31, 2011. We also performed an analysis in which we assessed the competing risk of death on the primary outcome according to methods of Fine and Gray¹¹¹. For all statistical tests, $p < 0.05$ was considered statistically significant. Statistical analyses were done using STATA version 11.2 (Statacorp, College Station, TX). The institutional review board of the University of Calgary approved this study and granted waiver of patient consent.

4.4 Results

4.4.1 Cohort Formation and Characteristics

We identified 39,203 subjects 18 years of age and older with incident diabetes and at least one hospitalization between January 1, 2004 and March 31, 2011. We excluded 5,392 subjects (Figure 4.1), for a final study cohort of 33,811. The mean age (SD) of the cohort was 63.5 (15.4) yrs and 53.4% were male (Table 4.2). Chronic obstructive pulmonary disease (COPD), hypertension, cancer, and CHF were the most common co-morbid conditions. Approximately half of the cohort (49.4%) had at least 1 A1c measurement and 68.9% had a serum creatinine measurement in the six-month period prior to their index hospitalization. Table 4.3 describes the health care utilization of the study cohort and characteristics of the index hospitalization. In the

1-year period prior to the index event, 3.4% and 44.1% of patients had no visits to an outpatient primary care physician or emergency department respectively. Injury/accident and diagnoses related to the circulatory system were the most common most responsible diagnoses for the index hospitalization. Approximately 80% of patients were discharged home from the index hospitalization with 1.1% of patients signing out against medical advice.

4.4.2 Association Between Health System Use and All-cause Subsequent Hospitalization

The mean (SD) follow-up time for subjects was 0.68 (0.3) years. During this study period, 11,095 patients with diabetes experienced a subsequent all-cause hospitalization, 1,033 (9.3%) died after their index hospitalization, and 355 (3.2%) out-migrated from the province. Using Cox models adjusting for patient-level characteristics and factors related to the index hospitalization, we found that emergency department visits, primary care physician visits, and discharge disposition were all associated with an increased risk of subsequent hospitalization (Figure 4.2). Compared to subjects with no emergency department visits in the 1-year period prior to the index hospitalization, there was a 4 percent increased risk of a subsequent hospitalization for every additional emergency department visit (Adjusted HR 1.04, 95% Confidence Interval [CI] 1.03–1.05). Though not statistically significant, patients with no visits to a primary care physician were more likely to have a repeat hospitalization compared to those with 1-4 visits (Adjusted HR 1.11, 95% CI 0.99–1.25), while patients with five or more visits were significantly more likely to experience a subsequent hospitalization (5-9 visits; Adjusted HR 1.06, 95% CI 1.00–1.12; ≥ 10 visits; Adjusted HR 1.23, 95% CI 1.16–1.29). Finally, compared to patients discharged home, those discharged home with support services were more likely to have a subsequent all-cause hospitalization. This risk was almost two-fold higher for patients that signed out against medical

advice (Adjusted HR 1.74, 95% CI 1.50–2.02) (Table 4.4).

4.4.3 Association Between Health System Use and Cause-specific Subsequent Hospitalization

A total of 867 cardiovascular-specific and 409 diabetes-specific subsequent hospitalizations were identified in the 1-year follow-up period. Similarly, each additional emergency department visit in the year prior to the index event was associated with an increased risk of cardiovascular-specific and diabetes specific subsequent hospitalization compared to patients with no emergency department visits (Table 4.5). There was no association between primary care physician visits and cause-specific subsequent hospitalization. Patients that were discharged against medical advice were more than twice as likely to have a subsequent cardiovascular-specific hospitalization (Adjusted HR 2.11, 95% CI 1.13–3.97) and almost 3 times more likely to have a diabetes-specific repeat event (Adjusted HR 2.86, 95% CI 1.82–4.49).

4.4.4 Sensitivity Analyses

Sensitivity analyses excluding patients with less than one year of follow-up (n=6,138) did not change the risk of subsequent all-cause or cause-specific hospitalization (Table 4.6). Treating death after discharge from the index hospitalization as a competing risk had a slight influence on the observed associations between our exposures of interest and risk of subsequent all-cause hospitalization (Table 4.7). In a competing risks regression model, subjects with no primary care physician visits in the year prior to the index event were statistically more likely to have the outcome of interest ($p = 0.040$). In addition, subjects discharged to palliative care or long-term care settings were statistically less likely. All remaining point estimates were similar to those observed in our multivariate Cox proportional hazards model.

4.5 Discussion

In this large, population-based cohort of adults with diabetes and at least one hospitalization, we found that features of health system use are associated with an increased risk of subsequent hospitalization. Specifically, prior emergency department visits, limited or increased use of primary care, and discharge against medical advice were all associated with an increased risk of this adverse event. Given the financial burden that in-patient care places on the health care system, the ability to identify and modify factors associated with subsequent hospitalization may help healthcare providers reduce the risk of subsequent hospitalization for these high-risk patients.

Our results add to those observed in previous studies. Smith et al. found that the number of emergency department visits in the 6-month period prior to hospitalization was a significant predictor of 90-day repeat hospitalization among patients with chronic disease⁽¹¹²⁾. Though their cohort included a subgroup of patients with diabetes, our results show this association consistently in a large cohort of patients with diabetes with similar associations for both all-cause and cause-specific subsequent hospitalization. The fact that patients with diabetes are more likely to use emergency department visits may be attributed to a number of different factors. It is possible that acute care utilization represents a patient's general health status or the severity/complexity of a patients' baseline disease. Multi-morbidity is common amongst patients with diabetes^{6, 64, 113} and acute complications may explain the increased use of acute care facilities and the potential increased risk of subsequent hospitalization. It is also possible that emergency department use represents limited access to primary care services based on geographic location, or patients' with no regular primary care provider. The identification of the

latter represents an area for future research aimed at improving care for patients with diabetes.

We also observed a J-shaped relationship between the number of primary care physician visits and risk of subsequent all-cause hospitalization. In various chronic disease populations, increased primary care accessibility and use has been associated with decreased risk of hospitalization, especially for ambulatory care sensitive conditions ^{114, 115}. In diabetes populations specifically, multiple physician visits have been shown to increase the risk of first hospitalization ¹¹⁶. Our results extend these findings and suggest that a higher number of primary care physician visits are in fact associated with a greater risk of subsequent hospitalization as well. Though diabetes is considered a condition amenable to management in a primary care setting, those with multiple visits may represent patients requiring complex care or could be a proxy measure for the severity of their condition.

In addition, we found a potential increased risk of subsequent all-cause hospitalization in patients with no primary care physician visits prior to their index event. Though only significant in our sensitivity analysis, these results support previous literature showing that limited access is associated with increased hospitalization risk in chronic disease populations ^{44, 46, 117}. Future work is required to identify characteristic of these patients at high risk and determine whether no health care use in the period prior to hospitalization represents limited access or health behaviors in which a patient chooses not to seek care.

A unique finding within our study was the differential association between discharge disposition and risk of repeated hospitalization. Specifically, we found that patients discharged to palliative

or long-term care were less likely to have a subsequent hospitalization, possibly given the competing risk of death, whereas those discharged against medical advice were significantly more likely. In a cohort of elderly patients with diabetes identified within the California State Inpatient Dataset, Kim et al. found that a discharge disposition other than home was associated with an increased risk for an unscheduled subsequent hospitalization (OR 1.28, 95% CI 1.24–1.32)⁹⁷. However, their dichotomous analysis could not determine how different transitions of care place patients with diabetes at different risk for subsequent hospitalization. Importantly we found a significant increase in the risk of all-cause as well as cardiovascular and diabetes-specific subsequent hospitalization among patients that were discharged against medical advice.

Previous studies exploring discharge from hospital against medical advice have been limited primarily to the general population, and have been shown to be associated with increased mortality and readmission^{118, 119}. Younger age, male sex, poor social support, psychiatric illness, drug or alcohol abuse are factors frequently associated with discharge against medical advice¹²⁰. Given the micro and macro-vascular complications associated with diabetes¹³, patients with diabetes who leave against medical advice represent a high-risk group worthy of future study to better understand the circumstances surrounding the discharge against medical advice.

Our study should be interpreted in light of its limitations. First, there are a number of factors that place patients at increased risk of subsequent hospitalization, including severity of disease, and thus, the possibility of residual confounding exists given our administrative data sources.

However, we were able to adjust for a number of patient and clinical characteristics, including laboratory tests, which may represent proxy measures of disease severity. Second, we were

unable to determine whether a patient had a regular primary care physician, or the level of coordination available during the transition from the hospital to community care. Continuity of care and physician accessibility has been associated with improved outcomes, particularly in diabetes^{44, 46, 117}. Our inability to adjust for these factors may also confound the observed associations. Finally, we assessed all-cause and cause-specific subsequent hospitalizations irrespective of the index hospitalization diagnosis, which makes the interpretation of these associations less clear. However, patients with diabetes often suffer from various micro and macro-vascular complications of their condition. Studies have shown that patients with diabetes are often hospitalized due to one or more of these complications¹³. Further, we felt that any hospitalization (regardless of type) represents a significant burden on the health care system. For these reasons, we believed it was justifiable to consider all hospitalizations that occurred among the study population.

Despite these limitations, our study has a number of strengths. We used population-based administrative data and laboratory data within a single province of Canada which provides a unique opportunity to comprehensively assess the issue of subsequent hospitalization in patients with diabetes. Our research was also grounded in a recognized framework for the study of health care utilization, using the Andersen Behavioral Model, and our results highlight the need for researchers and clinicians to consider health resource use and discharge disposition in context of the known patient-level and clinical factors that place diabetes patients at risk for repeated hospitalization. Unlike many patient and clinical characteristics, these associations observed could be considered modifiable and represent areas that require further exploration.

In summary, we found factors related to health system use are associated with an increased risk of subsequent hospitalization among patients with diabetes, including increased frequency of emergency department and primary care physician visits, as well as discharge from hospital against medical advice. We acknowledge that repeated hospitalization is a complex topic that requires an understanding of the multiple patient, provider and system level factors that influence it. Though subsequent hospitalization may represent progression in the natural history of the patient's underlying disease, or the consequences of poor coordination of care following discharge, strategies to identify and intervene on high-risk patients are essential as health care systems seek to reduce hospital utilization. Our results highlight the need to consider factors related to health system use when studying subsequent hospitalization. Inclusion of these factors may ultimately improve predictive accuracy of this outcome in future studies.

Table 4.1 ICD-10 codes for identification of cause-specific subsequent hospitalizations

Cardiovascular	ICD-10 Codes
Acute Myocardial Infarction	I21.x, I22.x, I25.2
Congestive Heart Failure	I09.9, I11.0, I13.0, I13.2, I25.5, I42.0, I42.5-42.9, I43.x, I50.x, P29.0
Stroke	H34.1, I60.x, I61.x, I63.x, I64.x, I67.7, G08, G45.x (excluding G45.4)
Diabetes	ICD-10 Codes
Diabetes	E10.x – E14.x

Table 4.2 Participant characteristics (n=33,811)

Characteristics	N (%)*
Age - years, Mean (SD)	63.3 (15.4)
Age Categories	
18-49	6509 (19.3)
50-64	11218 (33.2)
65-74	7639 (22.6)
≥ 75	8445 (24.9)
Male	18051 (53.4)
Rural Residence	6541 (19.4)
First Nations Status	1662 (4.9)
Median Neighborhood Household Income	
1 st quintile (lowest)	8086 (23.9)
2 nd quintile	7316 (21.6)
3 rd quintile	6423 (19.0)
4 th quintile	5985 (17.7)
5 th quintile (highest)	5200 (15.4)
Missing	801 (2.4)
Diabetes Duration - years, Median (IQR)	1.2 (0.4–2.6)
Charlson Co-morbidities	
Cancer	6299 (18.6)
Cerebrovascular Disease	4127 (12.2)
Congestive Heart Failure (CHF)	5435 (16.1)
Chronic Obstructive Pulmonary Disease (COPD)	10269 (30.4)
Dementia	2275 (6.7)
HIV/AIDS	50 (0.2)
Metastatic Solid Tumor	1496 (4.4)
Myocardial Infarction	5098 (15.1)
Mild Liver Disease	1188 (3.5)
Moderate/Severe Liver Disease	408 (1.2)
Para/Hemiplegia	803 (2.4)
Peptic Ulcer Disease	1611 (4.8)
Peripheral Vascular Disease	2676 (7.9)
Renal Disease	2714 (8.0)
Rheumatologic Disease	1225 (3.6)
Hypertension	7095 (21.0)
Affective Disorder	3340 (9.9)
At least 1 A1c measurement in 6 month period prior to index hospitalization	16698 (49.4)
eGFR Category (mL/min/1.73m ²)	
≥ 90	7220 (21.4)
90-60	10391 (30.7)
59-45	3210 (9.5)
44-30	1722 (5.1)
29-15	625 (1.8)
< 15	132 (0.4)
No measurement in 6 month period prior to index hospitalization	10511 (31.1)

*All values expressed as proportions unless otherwise specified

Table 4.3 Health care utilization and characteristics of the index hospitalization

Characteristics	N (%)*
Number of Primary Care Physician Visits†	
0	1133 (3.4)
1-4	7655 (22.6)
5-9	12487 (36.9)
≥ 10	12536 (37.1)
Number of Emergency Department Visits†	
0	14915 (44.1)
1	8161 (24.1)
2	4216 (12.5)
≥ 3	6519 (19.3)
Length of stay during index hospitalization, days, median (IQR)	5 (3-10)
<5	14730 (43.6)
5-9	10044 (29.7)
≥ 10	9037 (26.7)
Hospitalization type for index hospitalization	
Elective	10034 (29.7)
Emergent/Urgent	23777 (70.3)
Most Responsible Diagnosis of index hospitalization	
Cancer	2999 (8.9)
Mental Health	1627 (4.8)
Circulatory	5565 (16.4)
Respiratory	2559 (7.6)
Digestive	4154 (12.3)
Musculoskeletal	3129 (9.2)
Urinary	2662 (7.9)
Injury / Accident	6152 (18.2)
Other	4964 (14.7)
Discharge disposition of index hospitalization	
Transferred to long-term care facility	1415 (4.2)
Transferred to palliative/hospice	129 (0.4)
Discharged to home setting with support services	4754 (14.1)
Discharged home	27123 (80.2)
Signed out against medical advice	390 (1.1)

*All values expressed as proportions unless otherwise specified

† In 1-year period prior to index hospitalization

Table 4.4 Factors related to health system use associated with subsequent *all-cause* hospitalization within 1 year of discharge from an index hospitalization among patients with diabetes

	Unadjusted Model HR (95% CI)	Multivariate Adjusted Model* HR (95% CI)
# of emergency department visits in the 1-year period prior to the index hospitalization		
0	Reference	Reference
Per visit	1.05 (1.04–1.06)	1.04 (1.03–1.05)
# of primary care physician visits in the 1-year period prior to the index hospitalization		
0	1.26 (1.13–1.41)	1.11 (0.99–1.25)
1-4	Reference	Reference
5-9	1.08 (1.02–1.14)	1.06 (1.00–1.12)
≥ 10	1.48 (1.41–1.56)	1.23 (1.16–1.29)
Discharge Disposition of index hospitalization		
Discharged Home	Reference	Reference
Transfer to Palliative Care	1.46 (1.04–2.03)	0.86 (0.62–1.21)
Transfer to Long-term Care	1.29 (1.17–1.41)	0.75 (0.68–0.84)
Discharged Home with Support Services	1.55 (1.48–1.63)	1.13 (1.08–1.20)
Discharged Against Medical Advice	1.85 (1.60–2.13)	1.74 (1.50–2.02)

*Adjustment for patient level factors (Age, sex, diabetes duration, neighborhood income quintile, urban/rural status, First Nations status, A1c measurement in past 6 months (Y/N), eGFR category prior to index hospitalization, hypertension, affective disorder, Charlson co-morbidities (cancer, congestive heart failure, COPD, dementia, metastatic solid tumor, myocardial infarction, mild liver disease, moderate/severe liver disease, paraplegia/hemiplegia, peptic ulcer disease, peripheral vascular disease, renal disease, rheumatic disease) and factors related to index hospitalization (most responsible diagnosis and length of stay)

Table 4.5 Factors related to health system use associated with subsequent *cardiovascular and diabetes-specific* hospitalization within 1 year of discharge from an index hospitalization among patients with diabetes

	Cardiovascular-specific		Diabetes-specific	
	Unadjusted Model HR (95% CI)	Adjusted Model* HR (95% CI)	Unadjusted Model HR (95% CI)	Adjusted Model† HR (95% CI)
# of emergency department visits in the 1-year period prior to the index hospitalization				
0	Reference	Reference	Reference	Reference
Per visit	1.05 (1.03–1.06)	1.03 (1.01–1.05)	1.05 (1.03–1.07)	1.03 (1.01–1.05)
# of primary care physician visits in the 1-year period prior to the index hospitalization				
0	1.11 (0.73–1.68)	0.95 (0.63–1.44)	1.71 (1.16–2.52)	1.08 (0.73–1.60)
1-4	Reference	Reference	Reference	Reference
5-9	1.05 (0.86–1.27)	0.97 (0.80–1.18)	0.54 (0.42–0.69)	0.78 (0.61–1.02)
≥ 10	1.54 (1.29–1.85)	1.10 (0.91–1.33)	0.63 (0.50–0.81)	0.96 (0.74–1.26)
Discharge Disposition of index hospitalization				
Discharged Home	Reference	Reference	Reference	Reference
Transfer to Palliative Care	--	--	1.11 (0.16–7.88)	1.24 (0.17–9.00)
Transfer to Long-term Care	2.14 (1.62–2.82)	0.78 (0.58–1.05)	0.49 (0.24–1.05)	0.63 (0.29–1.37)
Discharged Home with Support Services	2.34 (2.00–2.73)	1.26 (1.07–1.50)	1.14 (0.86–1.51)	1.32 (0.98–1.81)
Discharged Against Medical Advice	1.38 (0.74–2.58)	2.11 (1.13–3.97)	5.54 (3.60–8.54)	2.86 (1.82–4.49)

*Adjustment for patient level factors (Age, sex, urban/rural status, A1c measurement in past 6 months (Y/N), eGFR category prior to index hospitalization, hypertension, Charlson co-morbidities (cerebrovascular disease, congestive heart failure, myocardial infarction, renal disease) and factors related to index hospitalization (most responsible diagnosis and length of stay)

†Adjustment for patient level factors (Age, sex, urban/rural status, A1c measurement in past 6 months (Y/N), eGFR category prior to index hospitalization, hypertension, affective disorder, Charlson co-morbidities (cerebrovascular disease, congestive heart failure, myocardial infarction, peripheral vascular disease) and factors related to index hospitalization (most responsible diagnosis and length of stay)

Table 4.6 Sensitivity analysis: Factors related to health system use associated with subsequent *all-cause, cardiovascular and diabetes-specific* hospitalization among patients with diabetes with at least 1 year of follow-up time

	All-cause	Cardiovascular-specific	Diabetes-specific
	Adjusted Model* HR (95% CI)	Adjusted Model† HR (95% CI)	Adjusted Model†† HR (95% CI)
# of emergency department visits in the 1-year period prior to the index hospitalization			
0	Reference	Reference	Reference
Per visit	1.04 (1.03–1.05)	1.03 (1.02–1.05)	1.04 (1.01–1.06)
# of primary care physician visits in the 1-year period prior to the index hospitalization			
0	1.13 (1.00–1.27)	1.01 (0.66–1.54)	1.10 (0.73–1.67)
1-4	Reference	Reference	Reference
5-9	1.06 (1.00–1.13)	0.96 (0.78–1.18)	0.80 (0.61–1.05)
≥ 10	1.23 (1.16–1.30)	1.04 (0.85–1.28)	0.92 (0.69–1.22)
Discharge Disposition of index hospitalization			
Discharged Home	Reference	Reference	Reference
Transfer to Palliative Care	0.96 (0.68–1.35)	--	1.45 (0.20–10.50)
Transfer to Long-term Care	0.76 (0.68–0.85)	0.68 (0.49–0.94)	0.52 (0.21–1.31)
Discharged Home with Support Services	1.13 (1.07–1.20)	1.19 (0.99–1.43)	1.42 (1.03–1.97)
Discharged Against Medical Advice	1.62 (1.39–1.90)	2.13 (1.09–4.13)	2.77 (1.70–4.53)

*All-cause model - Adjustment for patient level factors (Age, sex, diabetes duration, neighborhood income quintile, urban/rural status, First Nations status, A1c measurement in past 6 months (Y/N), eGFR category prior to index hospitalization, hypertension, affective disorder, Charlson co-morbidities (cancer, congestive heart failure, COPD, dementia, metastatic solid tumor, myocardial infarction, mild liver disease, moderate/severe liver disease, paraplegia/hemiplegia, peptic ulcer disease, peripheral vascular disease, renal disease, rheumatic disease) and factors related to index hospitalization (most responsible diagnosis and length of stay)

† Cardiovascular-specific model - Adjustment for patient level factors (Age, sex, urban/rural status, A1c measurement in past 6 months (Y/N), eGFR category prior to index hospitalization, hypertension, Charlson co-morbidities (cerebrovascular disease, congestive heart failure, myocardial infarction, renal disease) and factors related to index hospitalization (most responsible diagnosis and length of stay)

††Diabetes-specific model - Adjustment for patient level factors (Age, sex, urban/rural status, A1c measurement in past 6 months (Y/N), eGFR category prior to index hospitalization, hypertension, affective disorder, Charlson co-morbidities (cerebrovascular disease, congestive heart failure, myocardial infarction, peripheral vascular disease) and factors related to index hospitalization (most responsible diagnosis and length of stay)

Table 4.7 Sensitivity analysis using competing risk regression for the association between health system use and subsequent *all-cause* hospitalization

	Adjusted Model (Cox Proportional Hazards Model) Hazard Ratio (95% CI)	Adjusted Model (Fine and Gray Competing Risk Model) Sub-hazard Ratio (95% CI)
# of emergency department visits in the 1-year period prior to the index hospitalization		
0	Reference	Reference
Per visit	1.04 (1.03–1.05)	1.04 (1.03–1.05)
# of primary care physician visits in the 1-year period prior to the index hospitalization		
0	1.11 (0.99–1.25)	1.12 (1.00–1.25)
1-4	Reference	Reference
5-9	1.06 (1.00–1.12)	1.06 (1.00–1.12)
≥ 10	1.23 (1.16–1.29)	1.24 (1.17–1.31)
Discharge Disposition of index hospitalization		
Discharged Home	Reference	Reference
Transfer to Palliative Care	0.86 (0.62–1.21)	0.49 (0.34–0.69)
Transfer to Long-term Care	0.75 (0.68–0.84)	0.65 (0.58–0.73)
Discharged Home with Support Services	1.13 (1.08–1.20)	1.12 (1.06–1.18)
Discharged Against Medical Advice	1.74 (1.50–2.02)	1.64 (1.41–1.92)

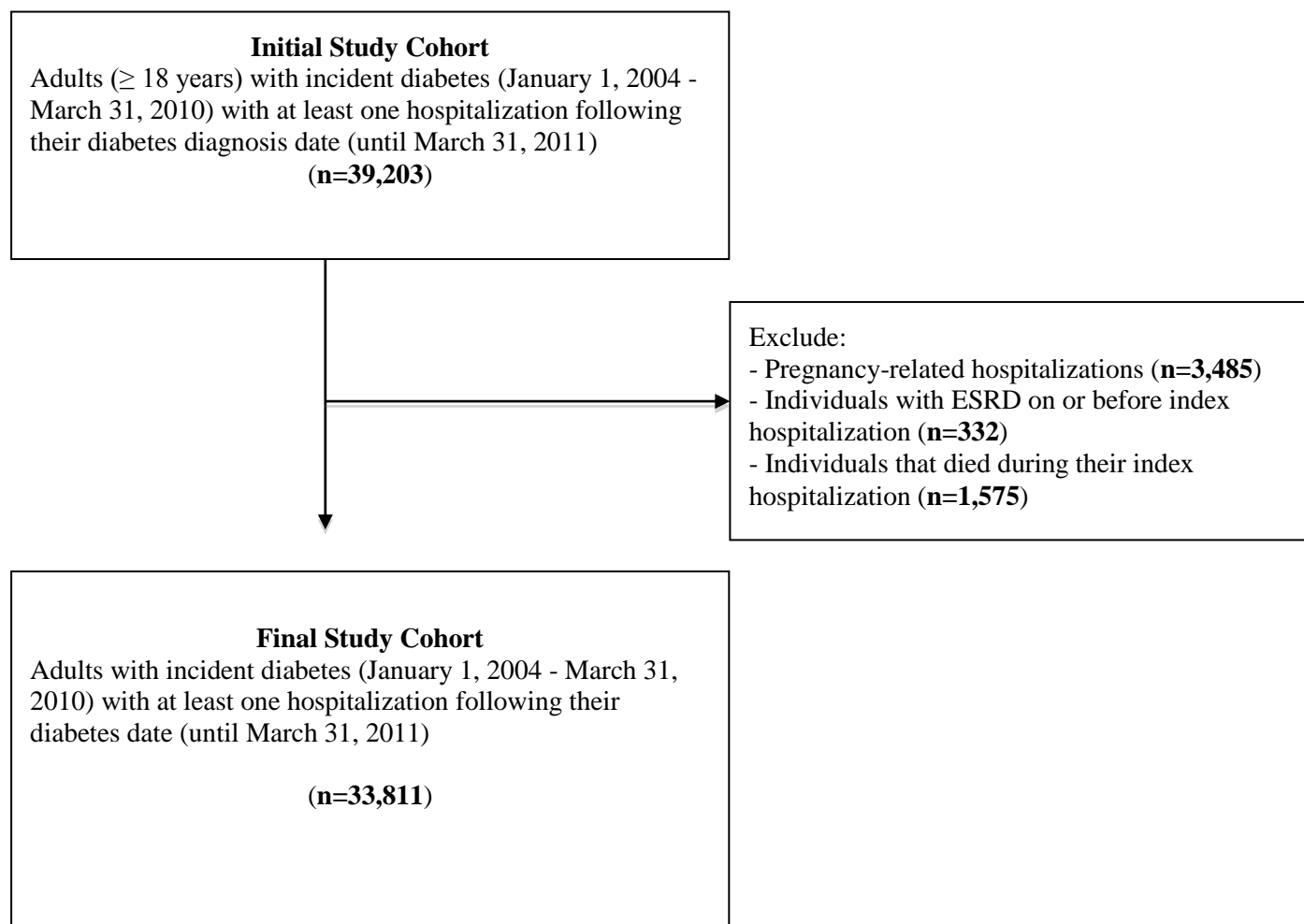
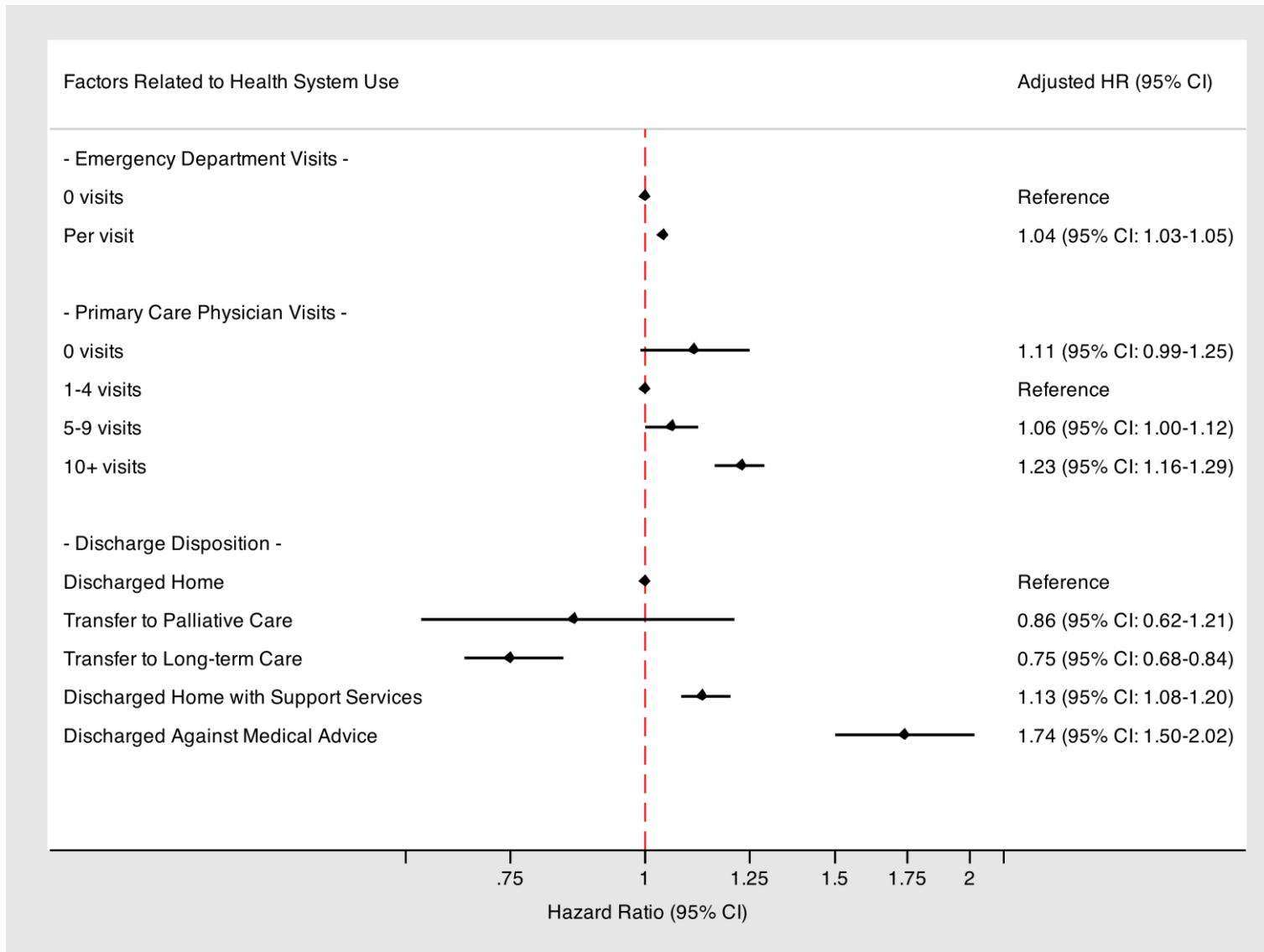
Figure 4.1 Flow diagram of cohort formation

Figure 4.2 Association between health system use and subsequent *all-cause* hospitalization



CHAPTER 5: SUMMARY

5.1 Barriers to Care Among Patients with Chronic Medical Conditions

Chronic medical conditions such as diabetes, hypertension, and heart disease are common in Canada and often occur together⁶⁻⁹. Despite the availability of effective treatments, many Canadians do not receive optimal care for these conditions³⁰⁻³⁵. This may be a result of a number of factors, including reduced access to health services. The overall objective of this thesis was to improve knowledge of barriers to care and its association with adverse outcomes among patients with chronic medical conditions. To address this objective, three studies were conducted using population-based survey data (CCHS), national and provincial administrative data sources (HPOI and AKDN) and novel data linkages between survey and hospitalization data.

Our first study provides a national perspective on the potential gaps in care for Canadians with chronic disease. Using a large, population-based survey of Canadians (CCHS), we found that the presence of chronic conditions was associated with an increased risk of perceived unmet health care need – a commonly used indicator of limited access to care^{42, 43}. Although these findings complement previous studies that have shown a high proportion of unmet health care need in patients with chronic disease compared to those without^{48, 50-52, 71}, our study adds to the literature by identifying how this association varied by the type and number of chronic conditions. Specifically, participants with multi-morbidity (that is, more than one chronic condition) were more likely to report a barrier to care. Furthermore, the most commonly reported reason for an unmet need was related to service availability, representing a potentially modifiable gap in chronic disease care.

5.2 Association Between Unmet Health Care Need and Adverse Outcomes Among Chronic Disease Populations

It is conceivable that an unmet need may result in delays in receiving medical attention and, in turn, result in worse health outcomes. Prior studies have shown that unmet needs are associated with higher rates of emergency department visits^{83, 84}, while others have found equivocal changes in rates of hospitalization and primary care physician visits in the general population⁴⁷. However, few studies have addressed the effect of unmet need and outcomes in a high-risk population of patients with chronic disease. In our second study, using a population-based survey (CCHS) linked to national hospitalization records, we found no association between perceived unmet health care need and risk of inpatient hospitalization (all-cause or cause-specific) among participants with chronic disease. Further, unmet need was not associated with features of the hospitalization including length of stay, hospital readmission, or in-hospital mortality.

Although unmet health care need was not associated with adverse outcomes when studied in an aggregate form, when we stratified our results by unmet need type, adults reporting a barrier related to resource availability, had a small but statistically significant increased risk of all-cause hospitalization, compared to those with no unmet needs. Not only do these findings highlight the need for a disaggregated approach to the study of unmet need in future studies, but suggest that specific system-level gaps in care may place chronic disease patients at greater risk for adverse outcomes.

Our final study explored factors related to health system use and their association with poor health outcomes among patients with diabetes. Using provincial administrative data, we found

that subsequent hospitalization was common among patients with diabetes and factors such as health resource use and discharge disposition were associated with increased risk for this outcome. Specifically, patients with previous ED visits and those discharged against medical advice were at greater risk for all-cause and cause-specific subsequent hospitalization. We also found that limited or increased use of primary care was associated with greater risk for this outcome. Whether these patterns of health resource use are related to limited access to primary care remains to be determined. Regardless, these results suggest the need for health service managers to examine practices in hospitals (e.g., early discharge criteria), as well as the availability of appropriate community services, coordination between hospital and community providers, and patient education and instruction for these high-risk groups.

5.3 Strengths and Limitations

While these three distinct studies contribute valuable information to our understanding of the gaps in care that exist for chronic disease populations, we must interpret these findings in light of their limitations. First, our measure of limited access to care was based on patient self-reported unmet health care need from the CCHS survey. Perceived unmet need is defined as the difference between services judged necessary to deal appropriately with health problems and services actually received^{42,43}. Although common to health surveys, this question requires an individual to make a judgment of medical necessity. The inherent subjectivity of this concept therefore makes it difficult to determine how a patient interprets this question. Specifically, a negative response might indicate that the respondent felt he or she had no need for health care, or that he or she needed care but endured a lengthy wait for care^{52,71}. Despite this limitation, we

have no reason to believe interpretation of this question would differ by type or number of chronic conditions present.

Second, we assessed the association between gaps in care and adverse outcomes. Although we were able to adjust for a number of factors that place patients at increased risk for hospitalization and subsequent hospitalization, there is still the possibility of residual confounding. Disease severity is one variable that is difficult to measure within survey or administrative data sources. However, we were able to adjust for the number of chronic conditions, which can be considered a proxy for disease severity. We also used laboratory data within the AKDN where possible to define severity based on clinical findings. This included estimates of kidney function (eGFR) and blood glucose control (A1c measurements).

Third, we were unable to determine how characteristics of the health care system, including health policies and availability of providers affect access to care among chronic disease populations. Although decision makers are interested in understanding the influences of health policy and organization of health care use, and are highlighted in the Andersen Behavioral Model³⁹, these concepts are rarely included in the study of access. A systematic review by Phillips et al. showed that only 45% of studies implementing the Andersen model used system variables in their analysis of health care use¹²¹. Limited use may be attributed to the fact that these variables are often measured at the population level, not the individual level, resulting in the need for complex multi-level modeling techniques for analysis. While we were unable to adjust for these specific variables, our analyses did account for a number of patient/provider characteristics as well as important indicators of health system use. This limitation also

represents an area for future research and highlights the need for novel data linkages to further improve our understanding of the complex concept of access to care.

Despite these limitations, there are a number of strengths in these studies that should be highlighted. First, our studies utilized population-based survey and administrative data sources within Canada (studies one and two) and Alberta specifically (study three). This provided a unique opportunity to comprehensively assess the association between access to care and adverse outcomes among chronic disease populations. Linking survey and national administrative data also enabled exploration of questions that neither dataset could answer on their own and highlights the utility of data linkage within health services research. Second, our research was grounded in a recognized framework for the study of health care utilization and access to care, using the Andersen Behavioral Model³⁹. This model was appropriate for the study of unmet needs in chronic disease populations due to the availability of operationalized measures of limited access in addition to the various patient/ provider factors and variables related to health system use that influence access. Finally, we studied the influence of multi-morbidity and its relation to access and outcomes. Although the single disease model is still very common in health services research, there is a need to shift our thinking towards the co-occurrence of disease and how care can be modified to meet the needs of this high-risk group. The study of multi-morbidity is a strength of this thesis as it more clinically relevant to care providers as well as policy makers. Despite the heterogeneity observed within this group, the fact that multi-morbidity is common among elderly patients^{6, 14} also increases the generalizability of our study findings.

5.4 Future Directions and Policy Implications

Perceived unmet health care need is common among patients with chronic disease. We found that approximately 1 in 7 adults felt they needed health care but did not receive the care required. While this is concerning from a health care delivery standpoint, it appears that our current measures of limited access to care are non-specific and cannot discriminate between those at risk for adverse outcomes from those that are not. The need for future work to better understand the meaning of an “unmet need” and how patients interpret these questions in the setting of health surveys is required. In addition to the patient perspective, learning how decision makers interpret these findings and the information they would find helpful in the assessment of health care access would also be beneficial. Qualitative research and mixed-methods designs could potentially provide the richness that is currently lacking on these two fronts.

Patients living with chronic medical conditions perceive unmet health care need for a variety of reasons. These unmet needs can be related to lack of availability of health services, including health resources being unavailable in the area. It can also arise from individual accessibility problems, such as cost and transportation, from acceptability problems such as attitudes toward and knowledge about health care, or personal choices/circumstances that limit their ability to access care including decisions not to seek care or competing person/family responsibilities. Our results suggest that a component approach to the study of unmet need may be more informative. Specifically, we found that barriers related to availability of health resources were the most commonly reported among patients with chronic disease. These barriers were also associated with higher rates of hospitalization. Although improving availability of care and decreasing service wait times continue to top the Canadian health care agenda, future work must determine

whether interventions targeted to address these needs, including the expansion of primary care hours and increasing the number of after-hour clinics, would ultimately improve outcomes. There is also a need to explore the geographic barriers that exist for certain chronic disease patients and whether the use of new information technologies could improve access to primary and specialist care. The use of eHealth is one potential tool that has been shown to improve access in various populations¹²²⁻¹²⁴ and may reduce barriers to care for specific chronic disease groups.

A concerning finding was that barriers to care related to availability of health care services and lengthy wait times were highest amongst patients with multiple chronic conditions. Previous work has shown that a fragmented health care system, in which health care is delivered to patients by multiple care providers in multiple locations, may be detrimental to access for patients living with multi-morbidity^{125, 126}. The implementation of multi-disciplinary care clinics is one system level change with potential to reduce fragmentation and minimize gaps in care. This includes use of a multidisciplinary team that is responsible for coordinating diagnosis, treatment, and ongoing management and follow-up for patients. In addition to care from the primary care physician, consideration should be given to increasing use of allied health care professionals in primary care, and the expansion or revision of professional roles. For example, nurses and pharmacists could have a more active role in patient monitoring and adjustment of medications. Though individual components of this care model have been shown to be effective in improving outcomes in the setting of single chronic conditions¹²⁷⁻¹²⁹, its effectiveness in patients within multi-morbidity remains to be determined. This requires further investigation through randomized controlled trials and cost effectiveness studies.

Personal choices or circumstances were also commonly reported as a barrier to care. These included competing responsibilities and/or health behaviors that impeded a person from getting the care required. Further clarification of these specific barriers and the reasons they exist may help identify potential modifiable barriers. For example, if work-related responsibilities impeded care, the expansion of primary care hours and increasing the number of after-hour clinics may represent potential interventions to reduce unmet need in patients with chronic disease. These interventions may also influence health care behavior and decrease the use of acute care facilities, such as emergency department visits, for routine care.

Through novel data linkage, we were able to assess whether perceived unmet need was associated with an increased risk of hospitalization. Although the study of inpatient burden is important, given the cost associated with this outcome, an exploration of how patients with chronic disease and perceived barriers to care navigate the health care system may provide valuable insight into the association between gaps in care and additional health outcomes. As mentioned previously, it is possible that patients with unmet needs are accessing other aspects of the health care system to maintain their health status and avoid hospitalization. In prior studies, unmet needs have been associated with increased emergency department visits^{83, 84} and visits to general practitioners in emergency departments as opposed to primary care settings^{32, 47}. The fact that increased ED visits was associated with risk of subsequent all-cause and cause-specific hospitalization in our work supports the need for further research in this area. Future work may consider exploring the specific barriers that patients experience that lead to the use of acute care services.

The study of factors related to health system use and their association with adverse outcomes also provides valuable information for the study of barriers to care for patients with chronic disease. As diabetes is a condition that should be treated in an outpatient setting, our finding that patients with no primary care physician visits in the period prior to their index hospitalization are at greater risk for subsequent hospitalization is also worthy of further exploration. Results from our first study using the CCHS indicate that 95% of patients with chronic disease report having a regular family doctor. Based on these findings, it is important to determine whether limited primary care utilization in our final study is capturing the small proportion with no access to primary care or is a function of health behaviors among patients with diabetes. Even with the strikingly high proportion of patients that report having a regular medical doctor, enduring lengthy wait times to get an appointment with their regular care provider or specialist may explain the unmet health care need that still remains. This also alludes to the need for expanded clinic hours and the implementation of multi-disciplinary care clinics to potentially improve access to care.

Finally, when studying unmet health need in epidemiological research, it is important to determine if the exposure (presence of a gap in care) precedes the outcome of interest. With respect to the association between unmet need and adverse outcomes, future prospective studies are required to establish the utility of this measure of limited access to inform health policy. Though the presence of a temporal association does not imply causality, it would provide strength for its use in the study of gaps in care and health outcomes. It is also important to determine if an unmet need reported at the beginning of a study was sustained throughout follow-up or represents a short-term need that was resolved. This would require multiple

measures of unmet needs over time and the use of this variable as a time varying covariates in the analysis of a future prospective cohort study.

5.5 Conclusions

Despite a universal health care system, gaps in care for patients with chronic medical conditions remain. Approximately 1 in 7 adults with chronic disease report a perceived unmet health care need. Furthermore, specific types of barriers to care, namely limited resource availability and lengthy wait times, were associated with increased rates of hospitalizations. Limited access to primary care may also increase the risk of subsequent hospitalization. These findings suggest there are potential areas that can be modified to improve care for patients living with chronic disease. Further understanding of the concept of unmet health care need and the various factors that influence it are required. This will not only inform areas for future intervention aimed at enhancing and improving management of those chronic medical conditions, but will provide decision-makers with key findings that can translate into policy change.

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