12-8-2020 2:00 PM

Correlates of Preventable Emergency Department Visits in Canada: Evidence from the Literature and the Canadian Community Health Survey

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A thesis submitted in partial fulfillment of the requirements for the Master of Science degree in Epidemiology and Biostatistics

Abstract

Emergency department (ED) visits for primary healthcare-treatable conditions are preventable and indicate barriers to primary healthcare. The goal of this thesis was to explore the prevalence and key correlates of preventable ED visits among adults in Canada. Our systematic review found that the prevalence of these visits ranged from 4.3% to 59.1% and were associated with younger age, low education, low income, rural residence, and worse self-rated health. Our analysis of data from the 2015-2016 Canadian Community Health Survey found that 39.9% of adults with a regular healthcare provider considered their last ED visit to be preventable. In addition to age, education, and income, these visits were associated with being female, being employed, non-white ethnicity, having no recent consultations with a medical doctor, a strong sense of community belonging, and worse self-rated mental health. Future research should explore the healthcare experiences of these sub-populations to improve their access to care.

Keywords

Emergency department, primary healthcare, health surveys, systematic review, cross-sectional studies, Canada

Summary for Lay Audience

Countries around the world have experienced a rapid increase in emergency department (ED) visits over the past decade, which contributes to healthcare problems such as hospital overcrowding and increased wait times. While EDs are meant to provide emergency care to those with life-threatening injuries and illnesses, an increasingly large proportion of ED visits are being made for reasons or conditions that could be treated or appropriately managed in primary care settings. These visits are considered to be preventable, as patients should be able to receive care from a primary healthcare provider (HCP) rather than visit the ED for a health problem that could have been otherwise treated or managed at the level of primary healthcare. It is important to identify the patient characteristics and factors associated with these visits so that healthcare policies can be developed to better address patients' healthcare needs. Therefore, the goal of this thesis was to estimate the proportion of ED visits in Canada that are preventable and to identify factors that may increase patients' likelihood of having a preventable ED visit.

We summarized the findings from previous Canadian studies and found that 4.3% to 59.1% of ED visits were reported to be preventable. Patients who were of younger age, low education, low income, lived in rural areas, and had worse self-rated health were more likely to have a preventable ED visit. We also analyzed data from the 2015-2016 Canadian Community Health Survey and found that 39.9% of adults with a regular HCP considered their last ED visit to be preventable. In addition to age, income, and education, patients who were female, employed, of non-white ethnicity, had no recent consultations with a medical doctor, had a strong sense of community belonging, and had worse self-rated mental health were more likely to have a preventable ED visit. In conclusion, a considerable proportion of ED visits in Canada are preventable, and patients with certain characteristics are more likely to have a preventable ED visit. Future research that explores the healthcare experiences of these patients would assist healthcare policymakers in better understanding their difficulties in accessing primary healthcare.

Co-Authorship Statement

This thesis includes two integrated articles, each of which has been or will be submitted for publication in a peer-reviewed journal. The co-author details are presented below.

Chapter 2: Lau T, Sriskandarajah C, Wilk P, and Ali S. What are the Determinants of Preventable Emergency Department Visits? A Systematic Review of the Literature. Submitted for publication to an academic journal.

Tammy Lau was responsible for the conception and design of the study, and performed the literature search, study screening and selection, data extraction, risk of bias assessment, analysis and interpretation of data, and wrote the first draft of the manuscript. Cynthia Sriskandarajah was the second reviewer of this study and performed the full text study screening and selection, data extraction, and risk of bias assessment. Dr. Shehzad Ali was the third reviewer of this study and resolved any disagreements or discrepancies where a consensus could not be reached by the first and second reviewer. Dr. Piotr Wilk and Dr. Shehzad Ali were involved in the conception and design of the study and contributed to the interpretation of the data. All authors contributed to the subsequent revisions of the draft and approved the final manuscript.

Chapter 3: Lau T, Ali S, and Wilk P. Preventable Emergency Department Visits in Canada: An Analysis of the 2015-2016 Canadian Community Health Survey. Prepared for submission to an academic journal.

Tammy Lau, Dr. Shehzad Ali, and Dr. Piotr Wilk were involved in the conception and design of the study. Tammy Lau performed the statistical analysis, interpretation of the data, and wrote the first draft of this manuscript. Dr. Piotr Wilk was also involved in the statistical analysis and interpretation of the data. All authors contributed to the subsequent revisions of the draft.

Acknowledgments

I would like to express my deepest gratitude to my supervisor, Dr. Piotr Wilk, for his support and guidance throughout this Master's program. Dr. Wilk: Thank you for accepting me as your Master's student, sharing your epidemiological knowledge and expertise with me over these past two years, teaching me how to use SAS, and for providing invaluable feedback on my thesis drafts, which have undoubtedly improved the overall quality of this thesis. As well, thank you for providing opportunities for me to gain additional research experience and to grow as a researcher. Your humour and liveliness have made this thesis journey such a memorable experience – thank you for always taking the time to answer my questions, reassuring and encouraging me during stressful times, and sharing chocolates with me during our meetings. I would also like to extend my gratitude to my thesis advisory committee member, Dr. Shehzad Ali. Dr. Ali: thank you for sharing your knowledge and insights for this thesis and especially for the systematic review.

I like to express my appreciation to the staff and faculty in the Department of Epidemiology and Biostatistics at the University of Western Ontario. Thank you for teaching me everything that I know about epidemiology and biostatistics, sharing your research advice and experiences, and helping me expand my knowledge and further develop my critical thinking skills. I would also like to thank my classmates and friends in the Department of Epidemiology and Biostatistics. Some of my fondest memories of this program have been the times that we spent together – from our classroom interactions, studying together in the Kresge building, to our meet-ups and events within and outside of the school. We all came from different fields and walks of life, and I have learned so much from all of you.

Lastly, I would like to dedicate this thesis to my family. Aunt Ida: thank you for your endless support; your positive attitude and encouragements always cheered me up whenever I was feeling overwhelmed. To my grandma, 婆婆: thank you for teaching me the values of humility, compassion, diligence, and to put my best effort into everything that I do. Terrence: thank you for being the best brother anyone could ask for, always

making me laugh, and lending a listening ear whenever I needed someone to talk to. To my parents, Christine Yung and Francis Lau: words cannot begin to express the unconditional love that you have shown me and how grateful I am for everything that you have done for me. Thank you for always believing in me, comforting and encouraging me whenever I was worried or stressed, and instilling in me the values of integrity, hard work, and perseverance, which in turn have shape my work ethic. I would not be where I am today without you. Lastly to my grandfather, 公公: it was through your sacrifices that you provided the foundation for our family, and this is something I will never be able to thank you enough for. You always believed in the values of education, learning as a life-long journey, and encouraged everyone in our family to pursue higher education and our career aspirations no matter what. The strength and fearlessness that you demonstrated throughout your life helped me find my own strength when I was faced with hardships, and especially in the final stretches of this thesis. I love and miss you very much.

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Abbreviations

ACSC	Ambulatory care sensitive condition
AMUQ	l'Association des médecins d'urgence du Québec
AOR	Adjusted odds ratio
CAEP	Canadian Association of Emergency Physicians
CAI	Computer-assisted interviewing
CAPI	Computer-assisted personal interviews
CATI	Computer-assisted telephone interviews
CCA	Complete case analysis
CCHS	Canadian Community Health Survey
CCTB	Canadian Child Tax Benefit
CI	Confidence intervals
CIHI	Canadian Institute for Health Information
CPS	Canadian Paediatric Society
CTAS	Canadian Triage and Acuity Scale
CTAS NWG	Canadian Triage and Acuity Scale National Working Group
ED	Emergency department
FP	Family physician
FPSC	Family practice sensitive condition
GP	General practitioner
HCP	Healthcare provider
HQCA	Health Quality Council of Alberta
HQO	Health Quality Ontario
HR	Health region

ICD	International Classification of Diseases
ICES	Institute for Clinical Evaluative Sciences
LCL	Lower confidence limit
LFS	Labour Force Survey
LTC	Long term care
MAR	Missing at random
MCAR	Missing completely at random
MeSH	Medical subject heading
MI	Multiple imputation
MI-FCS	Multiple imputation by fully conditional specification
MNAR	Missing not at random
NA	Not applicable
NACRS	National Ambulatory Care Reporting System
NENA	National Emergency Nurses Association
NOS	Newcastle-Ottawa Quality Assessment Scale
NPR	Non-permanent resident
OR	Odds ratio
PaedCTAS	Canadian Paediatric Triage and Acuity Scale
PCP	Primary care provider
PHAC	Public Health Agency of Canada
PMM	Predictive mean matching
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PUMF	Public use microdata file
RDC	Research Data Centre
RR	Rate ratio

SD	Standard deviation
SES	Socioeconomic status
SNC	Sentinel non-urgent condition
SRPC	Society of Rural Physicians of Canada
SRS	Simple random sampling
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology
UCL	Upper confidence limit
UK	United Kingdom
UOR	Unadjusted odds ratio
US	United States
VIF	Variance inflation factor
WHO	World Health Organization

Chapter 1

1 Introduction

This chapter introduces the thesis by providing a brief overview of emergency departments (EDs), the increases in ED utilization over the past decade, and its associated consequences. It also introduces the concept of preventable ED visits, its impact on hospitals and patients, and its implications for primary healthcare. Finally, this chapter provides a rationale for the thesis, its overarching goal and research objectives, and concludes with an outline of the remaining chapters.

1.1 Overview of EDs

The history of EDs and emergency medicine is relatively young and goes hand-in-hand together [1, 2]. EDs first began as hospital emergency rooms that were staffed on a rotating basis by a mixture of residents, interns, family physicians (FPs), nurses, and other hospital physicians, with little to no coordination with other hospital services [1, 2]. It was not until the 1960s that emergency medicine became recognized as a medical specialty and EDs became formal departments within hospitals with their own dedicated team of emergency medicine specialists, physicians, nurses, and hospital staff [1, 2]. Although emergency medicine has evolved over the years, its core principals remain the same – to reduce preventable mortality, morbidity, and disability from time-sensitive processes through integrated systems for accessing and providing emergency care to the community [3, 4]. In 2007, the World Health Assembly – the governing body of the World Health Organization (WHO) – adopted the World Health Assembly Resolution 60.22, titled “Health Systems: Emergency Care Systems” [3, 5]. This was the first resolution to specifically focus on emergency care services and recognized its importance in providing immediate medical care to reduce the burden of diseases from acute injuries or illnesses and as a crucial component of the healthcare system [3, 4, 6]. As well, the resolution called upon governments around the world and the WHO to strengthen emergency care systems to better manage trauma and other emergency conditions, and

for greater involvement and attention in assessing the availability and quality of emergency care services and in providing these services to all who need them [3, 5].

EDs are an essential component of emergency care systems and play a key role in the delivery of healthcare [6, 7]. Their key features include around-the-clock availability, access to a wide range of comprehensive medical and diagnostic services [7], and mandate to provide care to all who visit the ED regardless of their citizenship, legal status, or ability to pay [8]. For vulnerable populations such as those without a usual source of care [9], without healthcare insurance [10], or those who face barriers to care due to ethnicity [11], socioeconomic status (SES) [12], geographic factors [13], or other psychosocial factors [14], the ED is often their sole or most accessible source of healthcare. In this capacity, the role and function of EDs have expanded to not only providing emergency medical care for trauma or acute injuries and illnesses, but also as a safety net for when other healthcare providers (HCPs) are unavailable or unable to provide care and as a key point of access to the healthcare system [7, 15].

1.2 Increases in ED Utilization

Over the past decade, EDs have experienced an unprecedented increase in visits and demand for emergency services [16]. In the United States (US) alone, the rate of ED visits significantly increased from 416.92 visits per 1,000 persons in 2010 to 448.19 visits per 1,000 persons in 2016 [17]. Other countries around the world including Australia, France, Germany, India, Italy, Spain, and the United Kingdom (UK) have reported annual increases ranging from 3% to 8% [18]. Canada, like many countries around the world, has also experienced a rapid and marked increase in ED visits [18, 19]. In 2018-2019, over 15 million ED visits were reported to the National Ambulatory Care Reporting System (NACRS) [20], which contains data from hospital-based and community-based ambulatory care across Canada [21]. As well, a report by Health Quality Ontario (HQO) found that ED visits in Ontario have increased by 11.3% over the past six years (from 5.3 million visits in 2011-2012 to 5.9 million visits in 2017-2018) [22].

The reasons and factors that contribute to these increases in ED utilization are complex and interrelated [23]. Demographic shifts in the population are partially responsible for this, as senior adults (ages 65 or older) constitute a large proportion of the population and are growing faster than the other age groups [24]. In Canada alone, senior adults are projected to represent between 23% to 25% of the population by 2036 [25], and by 2050 it is estimated that one in six people around the world will be over the age of 65 [26]. Senior adults often have more complex medical histories and co-morbidities that require greater medical care and attention [27, 28], use ED services at higher rates [29, 30], and have experienced the greatest increase in ED use compared to other age groups [31, 32]. The shift in the global burden of diseases also plays a role, along with advancements in technology and healthcare [33, 34]. As the rates of non-communicable diseases increase, people are living longer with chronic conditions and diseases and are also likely to experience further health complications that require acute care [24, 28, 35, 36]. The organization and delivery of healthcare also impact rates of ED visits – varying levels of healthcare insurance coverage, allocation of funding and healthcare resources, changes in healthcare practices, medical workforce shortages, or closures of hospital facilities places an increased demand and pressure on the hospitals and EDs that remain operational [33, 37, 38].

1.2.1 Consequences of Increased ED Utilization

These increases in ED utilization are associated with a number of consequences. ED overcrowding has been identified as a key issue in public health and emergency medicine in Canada [19], US [39], and many other countries around the world [16, 18]. ED overcrowding occurs when the demand for emergency services exceeds the ability for an ED to provide quality care within appropriate time frames [19], and is further associated with other healthcare problems including increased wait times, delays in patients being able to receive care or treatment, diminished quality of care, increased risk of adverse health outcomes, and dissatisfaction among patients and hospital staff [40-43]. ED overcrowding has been described as a “local manifestation of a systematic disease [41]” as it affects all levels of care and involves a number of factors ranging from individual patient characteristics, the organization and delivery of primary healthcare and health

services within the community, to hospital and ED factors that affect patient flow and the coordination of care [19, 41, 44, 45].

1.3 Preventable ED Visits

1.3.1 Conceptualization and Definition

Due to the increases in ED utilization and its associated negative consequences, there has been widespread attention from healthcare policymakers, HCPs, and researchers to better understand the causes and factors associated with these healthcare problems [46]. One strategy is to investigate the input component of ED utilization and overcrowding – characteristics or factors that affect the flow of patients into EDs and contribute to the demand for ED services [44] – and to better understand the patient characteristics of those seeking care in EDs, the factors involved in their decisions to visit the ED, and why they chose EDs over other health services [47, 48]. As early as the 1950s, studies on the patient characteristics of those who were visiting emergency rooms have found that a considerable proportion of patients were presenting with non-urgent or non-emergent reasons or conditions [49-51]. In 1993, a report by the US General Accounting Office found that 43% of all ED visits were classified as non-urgent, and the two main reasons for these visits were lack of access to primary healthcare and convenience [52, 53]. Given that EDs are intended to provide emergency care to those who have sustained acute or critical injuries and illnesses [7], it was believed that these types of visits detracted from their primary purpose and function as they could be treated or appropriately managed in primary care settings – thus these visits were identified as “preventable” ED visits [15, 54, 55].

While the consensus is that preventable ED visits are for reasons or conditions that could be treated or appropriately managed in primary care settings, their precise characterization, definition, and measurement remains unclear [15, 54-56]. Despite the large amount of attention and research that preventable ED visits have received, there is no universal or formal definition for these visits, nor are there any standardized methodology for identifying these visits [15, 54, 56, 57]. The terminology used for preventable ED visits is often inconsistent, as they have been called or described as “non-

urgent" [58], "unnecessary" [59], "avoidable" [60], "non-emergency" [61], or "inappropriate" [62]. HCPs have also used various types of measures and criteria, ranging from triage systems to assess the clinical urgency or acuity of the visit [57, 58, 62], vital signs or physiological cues of the presenting complaint [58, 62, 63], the type of presenting complaint or diagnosis [58, 61, 62], or the types of investigations performed and healthcare resources used during the ED visit [58, 62, 64]. Furthermore, there is a lack of congruence between HCPs and patients in terms of what constitutes a health emergency and of the appropriateness of an ED visit [63, 65, 66]. For HCPs, their perceptions of preventable ED visits are often based on the clinical urgency of the symptoms [63] and whether the problem is minor, non-acute, non-life-threatening, and could be treated in primary care settings [65]. On the other hand, patients' use of EDs are a complex interplay of sociodemographic and psychosocial factors that influence their recognition and assessment of their symptoms, need for care, and ultimately their decision to visit an ED [14, 63, 67]. For patients, their perceptions of their symptoms and need for care are based on the pattern of symptom onset [63], the seriousness and complexity of their health concerns [66], capacity to self-manage [59, 63], and the degree to which these symptoms cause pain, worry, anxiety, or discomfort [48, 59, 65]. It has also been found that patients' decisions to seek care in EDs rather than in other health services include considerations such as what each health service provides and the availability of healthcare resources at each health service [56, 65]. For patients, the key advantages of EDs include its convenience and accessibility, as it provides around-the-clock care and access to a wide range of medical and diagnostic services in a single location which are not available in primary care settings [48, 65]. Their anticipation of needing further care also plays a role, as seeking care in EDs reduces the complexities of having to make multiple appointments in different locations and reflects their anxiety, concern, and overall need for care [59, 65, 66, 68]. Because of these differing perspectives between patients and HCPs and even among HCPs and researchers themselves, there is a great deal of variation within the literature on how preventable ED visits have been defined and identified [57, 58].

1.3.2 Consequences of Preventable ED Visits

Despite these variations in how preventable ED visits are conceptualized and defined, they are associated with a number of negative consequences. Preventable ED visits amplify the already-existing high volumes of ED visits, contributing to the increased demands and pressures faced by EDs, hospitals, and the healthcare system [40, 58, 69]. Many HCPs consider these visits to be an inefficient use of healthcare resources and disruption to the flow and delivery of emergency care within EDs [40, 58, 69]. They also represent a financial burden, as costs of care for minor acute illnesses are higher in EDs than in primary care settings [70]. As well, preventable ED visits contribute to unnecessary or excessive testing, screening, use of diagnostic services or equipment, and potential duplication of services, further contributing to healthcare costs and inefficient use of healthcare resources [69, 71, 72]. Furthermore, use of EDs in lieu of primary healthcare disrupts the patients' continuity of care with HCPs [71, 73] and denies opportunities for patients to receive more long-term care and follow-up, health information and education, and preventative treatments and care that are important for maintaining and improving their overall health [74].

1.4 Implications of Preventable ED Visits for Primary Healthcare

Besides the impact of preventable ED visits on patients and hospitals, they also have implications for the delivery of primary healthcare. Primary healthcare is essential for maintaining and improving the health of individuals, the population, and for the overall function of the healthcare system [75-77]. It is defined by the WHO as, "a whole-of-society approach to health that aims to ensure the highest possible level of health and wellbeing and their equitable distribution by focusing on people's needs and preferences (as individuals, families, and communities) as early as possible along the continuum from health promotion and disease prevention to treatment, rehabilitation and palliative care, and as close as feasible to people's everyday environment" [78]. Primary healthcare is also important for primary prevention, early detection and treatment of illnesses, and for providing ongoing control, management, and follow-up of chronic conditions and diseases [79]. In Canada, primary healthcare is mainly delivered by FPs and it acts as a

first-contact health service that provides immediate care, routine care, health information, and coordination with other health services to ensure continuity of care and ease of movement across the healthcare system [80]. Based on the conceptualization that preventable ED visits are for reasons or conditions that could be treated or appropriately managed at the level of primary healthcare, preventable ED visits result from sub-optimal access to and care from primary care settings and indicate underlying health inequalities and disparities within and between populations [81-84].

1.4.1 Timely Access to Primary Healthcare

According to the Performance Measurement Framework developed by the Canadian Institute for Health Information (CIHI), access to comprehensive, high quality health services refers to "the capacity of the health system to offer the range of services that meets the need of individual patients and of the population in a timely fashion and without financial, organizational or geographical barriers to seeking or obtaining these services" [85]. A key component of access to care is timeliness [86] – in which patients are able to receive care within an acceptable period of time, the wait times are safe and appropriate [87], and efforts are made to reduce waits and harmful delays to those who receive and to those who give care [88]. Timely access to primary healthcare is crucial to ensure that patients are able to actually receive care when needed, to prevent the deterioration of health that could lead to further health complications, and to reduce their need to seek care from other places [89, 90]. Previous studies have found that patients who are able to obtain an appointment within the same day [91] or within two weekdays [92] were less likely to visit the ED. Patients' perceptions of timely access to primary healthcare or to their usual source of care also plays a major role in their healthcare-seeking behaviours and decisions. While having a usual source of care is associated with better access and ability to receive preventative treatments and ongoing care that are important for maintaining and improving health [74, 93], barriers to timely access such as being unable to schedule or obtain an appointment in a timely manner or long wait times at the HCP's office limits their ability to receive such care and is a key factor in their decisions to seek care in EDs instead [94].

1.4.2 Quality of Care

According to the WHO, quality of care is "the extent to which health care services provided to individuals and patient populations improve desired health outcomes" [95]. Using the framework developed by the Institute of Medicine, which has been adapted by the WHO, there are six dimensions to quality of care: safe, effective, timely, efficient, equitable, and patient-centred [88]. With high quality and appropriate primary healthcare, patients can receive preventative care and earlier, more ongoing management of health problems that can improve their health and lower their risk of suffering adverse health outcomes that may lead to ED visits that could have been otherwise avoided [77, 79]. Quality of care is also closely related to patient satisfaction and healthcare-seeking decisions [96, 97]. Patients who have more positive experiences and are more satisfied with the care they received from their HCP are more likely to develop a stronger patient-provider relationship [97, 98], have increased continuity of care with their HCP [99, 100], have improved adherence with medications and treatments [101, 102], and have better health outcomes [102, 103]. As well, patient dissatisfaction with their HCP and perceived poorer quality of care – including aspects such as lack of timely access [94, 104], poor patient-provider communication [98, 105], or lack of consideration of patients' preferences, needs, and values [106, 107] – are associated with an increased likelihood of seeking care in EDs instead.

1.4.3 Health Inequalities and Disparities

Lastly, preventable ED visits have implications for underlying health inequalities and disparities. Health inequalities are differences between individuals or populations in their access to care, health status, and health outcomes [108]. They are closely associated with health disparities, which arise from inequalities in the distribution of healthcare resources, access to care, and utilization of health services [109, 110]. According to *Healthy People 2020*, health disparities constitute a particular type of health difference that is closely linked with social or economic disadvantage that adversely affects populations that have systematically experienced greater social or economic obstacles to health-based characteristics that are historically linked to discrimination and exclusion (for example, race, ethnicity, religion, SES, gender, geographic location, or physical

and/or cognitive disabilities) [111, 112]. The association between ED utilization and health inequalities and disparities is well documented in the literature – previous studies have found that vulnerable populations such as those of racial or ethnic minorities, lower SES, or who live in rural or disadvantaged areas face greater barriers to accessing care [12, 113, 114], report greater unmet healthcare needs [115, 116], and use ED services at disproportionately higher rates [9, 82-84, 117]. Since preventable ED visits could be avoided or the risk of these visits could be reduced with timely access and appropriate care in primary care settings, high volumes of these visits – especially in vulnerable populations – indicate underlying health inequalities and disparities that impede their ability to access or receive appropriate care [81-84]. It is crucial to address and reduce health inequalities and disparities as they have widespread, detrimental effects on all members of society [118] and undermine the key function of healthcare systems – which is to provide equitable access to care and to deliver healthcare which protects and improves the health of individuals, families, and the population [119].

1.5 Thesis Rationale

The Canadian healthcare system is a universal, publicly funded healthcare system [80, 120]. Funding is provided at the federal level and allocated to each of the provinces and territories, which differ in the implementation and financing of health services and the amount of coverage for these services [80, 120]. In order to receive federal funding, the provincial and territorial healthcare insurance plans must follow the terms and conditions outlined by the *Canada Health Act*, which is Canada's federal legislation for publicly funded healthcare insurance [80, 120]. The *Canada Health Act* stipulates that all Canadians are guaranteed reasonable access to all medically necessary hospital, diagnostic and physician services without financial or other barriers [80, 120, 121].

While Canada generally performs well in terms of quality of care [122], timely access to primary healthcare remains a key issue in the healthcare system [123-125]. According to the Commonwealth Fund's 2016 International Health Policy Survey of 11 high-income countries (Canada, Norway, Sweden, US, Germany, France, Switzerland, UK, Australia, New Zealand, and the Netherlands), 74% of Canadian adults rated the medical care that they received from their regular doctor to be good or excellent, which was above average

and the second-highest among all countries (compared to 79% in New Zealand) [126]. Canada, however, reported the lowest percentage of adults who were able to obtain a same or next-day appointment with a doctor or nurse (43%), and that 41% of Canadian adults visited the ED for a condition that they believed could have been treated by their usual source of care if they had been available, which was the third-highest of all countries (compared to 42% in Germany and 47% in the US) [126]. In a report by CIHI, one in five ED visits – representing approximately 1.4 million visits – were for reasons or conditions that could be treated in a FP's office [127].

Given the increasing volumes of ED visits and the large proportion of these visits that are preventable, there is a need to further explore the magnitude and patterns of preventable ED visits and their relationship with primary healthcare. Much of the previous research on preventable ED visits, however, has originated from the US [128] or other countries [129-133]. As well, previously published systematic reviews that have synthesized the research on preventable ED visits have been conducted broadly across the literature [58, 62, 134] or specifically within the US [128]. There is a paucity of systematic reviews and original research that uses Canadian data sources to provide knowledge and information that would be relevant for informing healthcare policies and decisions within the Canadian context. Furthermore, in order for healthcare policies and interventions to be effective in reducing preventable ED visits and alleviating high rates of ED visits, it is crucial to identify the key correlates of these visits and sub-populations who face higher odds of having a preventable ED visit as this would indicate underlying health inequalities, disparities, and barriers to care that need to be addressed in order to improve access to care and the overall health and wellbeing of individuals and the population.

1.6 Thesis Goal and Research Objectives

The overarching goal of this thesis was to contribute to the body of Canadian research on preventable ED visits by exploring the prevalence of preventable ED visits among adults in Canada and identifying the key correlates of these visits among a broad range of patient characteristics and factors. This thesis had two research objectives:

(1) To conduct a systematic review to synthesize previous Canadian research on preventable ED visits, gain a better understanding of what has been previously explored and discovered in Canada, and to investigate the prevalence of preventable ED visits among adults in Canada and the patient-related factors associated with these visits.
(2) To use data from the 2015-2016 Canadian Community Health Survey (CCHS) to conduct a population-based, quantitative analysis of self-reported preventable ED visits among adults in Canada who have a regular HCP and to elucidate the key correlates of these visits.

1.7 Thesis Overview

This thesis was written in an integrated-article format and consists of two independent but interrelated studies that investigates preventable ED visits in the Canadian context.

Chapter 2 is a systematic review of the Canadian literature on preventable ED visits. This systematic review synthesized findings from previous studies to investigate the prevalence of preventable ED visits among adults in Canada and the patient-related factors associated with these visits. This systematic review was also conducted to gain a better understanding of the extent of the research that has been conducted on this topic in Canada and gaps in the literature that could benefit from further investigation. The findings from this systematic review were used to inform our second study (Chapter 3).

Chapter 3 is a population-based quantitative study that used data from the 2015-2016 CCHS to estimate the proportion of ED visits among adults in Canada with a regular HCP that were self-reported to be preventable, to explore the patient characteristics of those who had a preventable ED visit, and to assess the associations between these patient characteristics and preventable ED visits in order to identify the key correlates of these visits.

Chapter 4 summarizes and synthesizes the key findings from our two studies in the context of the broader literature. The strengths and limitations of our two studies, as well as directions for future research, are also discussed.

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Chapter 2

2 What are the Determinants of Preventable Emergency Department Visits? A Systematic Review of the Literature

2.1 Abstract

Background: Emergency department (ED) visits for reasons or conditions that could be treated or appropriately managed in primary care settings are considered to be preventable. To date, no systematic review has explored the determinants of these visits in the Canadian context. We conducted a systematic review to investigate the prevalence and patient-related factors associated with preventable ED visits among adults in Canada. **Methods:** We performed a literature search on MEDLINE, EMBASE, CINAHL, Web of Science, SCOPUS, and Cochrane Library, as well as grey literature and reference lists of the included studies. Data on the study design, setting, criteria used to identify preventable ED visits, prevalence of these visits, and patient-related factors were independently extracted by two reviewers. The data were qualitatively synthesized, and the risk of bias was independently assessed by two reviewers. **Results:** We identified 17 studies that met our inclusion criteria. The prevalence of preventable ED visits ranged from 4.3% to 59.1%. These visits were associated with younger age, low education level, low income, rural residence, and worse self-rated health. Common reasons for these visits included barriers to primary healthcare, perceived severity of symptoms, need for care, and positive perceptions of the convenience, accessibility, and quality of care in EDs compared to primary healthcare. **Conclusion:** Age, education level, income, rurality, and self-rated health are associated with preventable ED visits. Patients' perceptions of the urgency of their symptoms, need for care, and of the ease of accessibility and quality of care in EDs were driving factors for these visits.

Keywords: Emergency department, primary healthcare, patient acuity, systematic review, Canada

2.2 Introduction

Emergency departments (EDs) play a vital role in the delivery of healthcare. Over the past decade, countries around the world have reported annual increases in ED visits [1, 2]. In Canada, over 15 million ED visits were reported in 2018-2019 [3], and an international survey of 11 high-income countries revealed that 41% of Canadians visited an ED in the past two years, which was the highest percentage compared to the other countries [4]. These increases in ED visits are associated with negative consequences such as hospital overcrowding, increased wait times, increased risk of adverse patient outcomes, and excess costs to the healthcare system [5-8].

While EDs are intended to provide acute care to those who are critically injured or require immediate medical attention [9], they have been increasingly used for non-urgent, low acuity reasons or conditions that could be treated or appropriately managed in primary care settings [10-12]. These visits are considered to be preventable, as policymakers and healthcare providers (HCPs) believe that preventable ED visits place a burden on the healthcare system due to the misallocation of services and resources for visits that could be managed in primary care settings [13, 14]. Preventable ED visits also disrupt the continuity of care between patients and primary care providers (PCPs) [15] and deny opportunities for patients to receive health education, resources, and preventative treatments or care that are important for maintaining and improving their health [16]. Furthermore, under the *Canada Health Act*, Canadians are guaranteed reasonable access to health services without financial or other barriers [17]. High volumes of preventable ED visits, however, are indicative of underlying barriers to primary healthcare and suggest that sub-populations experience inequalities in accessing health services [18-20].

While previous systematic reviews on the patient characteristics and factors associated with preventable ED visits have been conducted in the United States (US) [21] and broadly across the literature [14, 22], to date there are no systematic reviews that examine this area in Canada specifically. To address this important gap in the literature, we conducted a systematic review to investigate the prevalence of preventable ED visits among adults in Canada and the patient-related factors associated with these visits.

2.3 Methods

2.3.1 Study Design

We conducted a systematic review of the literature on preventable ED visits in Canada, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [23] (Appendix A).

2.3.2 Search Strategy

A systematic literature search was conducted in September 2019 using the following databases: MEDLINE, EMBASE, CINAHL, Web of Science, SCOPUS, and Cochrane Library. An academic librarian assisted in developing our search strategy, which included a combination of MeSH and keywords for the concepts of EDs, preventable ED visits, and Canada. The search strategy was adapted for each database (see Appendix B for the search strategy used for MEDLINE), and there were no restrictions on the language or year of publication. Grey literature was searched on ProQuest (theses and dissertations) as well as Web of Science and SCOPUS. We also manually searched the references of the studies included in our systematic review for additional relevant studies.

2.3.3 Study Screening and Selection

Titles and abstracts were screened by one reviewer (T.L.). Studies were included if they investigated ED utilization in Canada among the adult population (age ≥ 18 years) and excluded if they exclusively investigated ED utilization among the paediatric population or were non-Canadian studies. We also excluded studies that exclusively investigated ED use among refugees, those who used drugs, and/or homeless adults as these are vulnerable sub-populations with unique healthcare needs and patterns of ED utilization that would not be generalizable to the broader population [24-26]. The full text of relevant studies was independently screened by two reviewers (T.L. and C.S.). While there is no universal or formal definition for preventable ED visits nor standardized methodology for identifying these visits [27-29], previous studies have used various objective or subjective measures such as a triage system [30, 31], lists of primary healthcare-treatable diagnoses or conditions [18, 32], or whether emergency physicians or

patients perceived the visit to be preventable [14, 33]. Based on this, we included studies if their primary outcome was preventable ED visits, defined as: (1) visits (identified by the authors of the study being screened) that could have been treated or managed by a PCP, or (2) study used a list of diagnoses or conditions to identify the visit as being primary healthcare-treatable, or (3) a triage system was used to classify patients as low acuity or non-urgent, or (4) the visit was self-reported or perceived by patients or physicians as preventable, or (5) used another criteria or method not listed above but was described within the study (Appendix C).

2.3.4 Data Extraction and Synthesis

Data extraction was independently conducted by two reviewers (T.L. and C.S.). We extracted data on the study design, location of study, data source, setting, comparison group(s) (if included in the study), and criteria used to identify preventable ED visits. Next, we extracted the proportion of ED visits that were categorized as preventable among the total number of ED visits, the descriptive statistics (frequency and percentages) of the patient-related factors, the effect measures (unadjusted and adjusted odds ratios (UOR and AOR, respectively), and rate ratios (RR)), along with their corresponding 95% confidence intervals (CI) and p-values. If studies included a comparison group, data were extracted for both groups. The data were then qualitatively synthesized. A quantitative synthesis was not feasible due to the heterogeneity in the methods used to identify preventable ED visits and in the reporting of the patient-related factors.

2.3.5 Risk of Bias Assessment

The risk of bias of the individual studies was independently appraised by two reviewers (T.L. and C.S.) using the Newcastle-Ottawa Quality Assessment Scale (NOS) [range: 0-9 points] for case-control and cohort studies [34] and an adapted version of the NOS for cross-sectional studies [range: 0-10 points] [35]. The NOS assesses studies in three domains: selection (four items), comparability (one item), and exposure/outcome (two items for cross-sectional studies; three items for case-control or cohort studies). Each item can receive a certain number of points (ranging from 0-1 or 0-2 points depending on

the item), and a higher score represents a lower risk of bias. The studies were categorized as low (7-10 points for cross-sectional studies; 7-9 points for case-control and cohort studies), moderate (4-6 points), or high risk of bias (0-3 points).

Any disagreements in the study screening, selection, risk of bias assessment, or discrepancies in the data extraction were resolved by discussion between the reviewers (T.L. and C.S.). In cases where a consensus could not be reached, disagreements and discrepancies were resolved by a third reviewer (S.A).

2.4 Results

2.4.1 Identification of Studies

Our search strategy retrieved 4,911 studies from the databases, and we identified an additional nine studies through our manual search of reference lists. After removing the duplicates, the titles and abstracts of 2,643 studies were screened. We identified 85 relevant studies and screened their full text. Of these, 68 studies were excluded for the following reasons: did not distinguish preventable ED visits from overall ED visits (n = 33), study outcome was not preventable ED visits (n = 10), did not state the criteria or method used to identify preventable ED visits (n = 5), were population duplicates (n = 9), or did not provide data on patient-related factors (n = 11). In total, 17 studies were included in our systematic review (Figure 2.1).

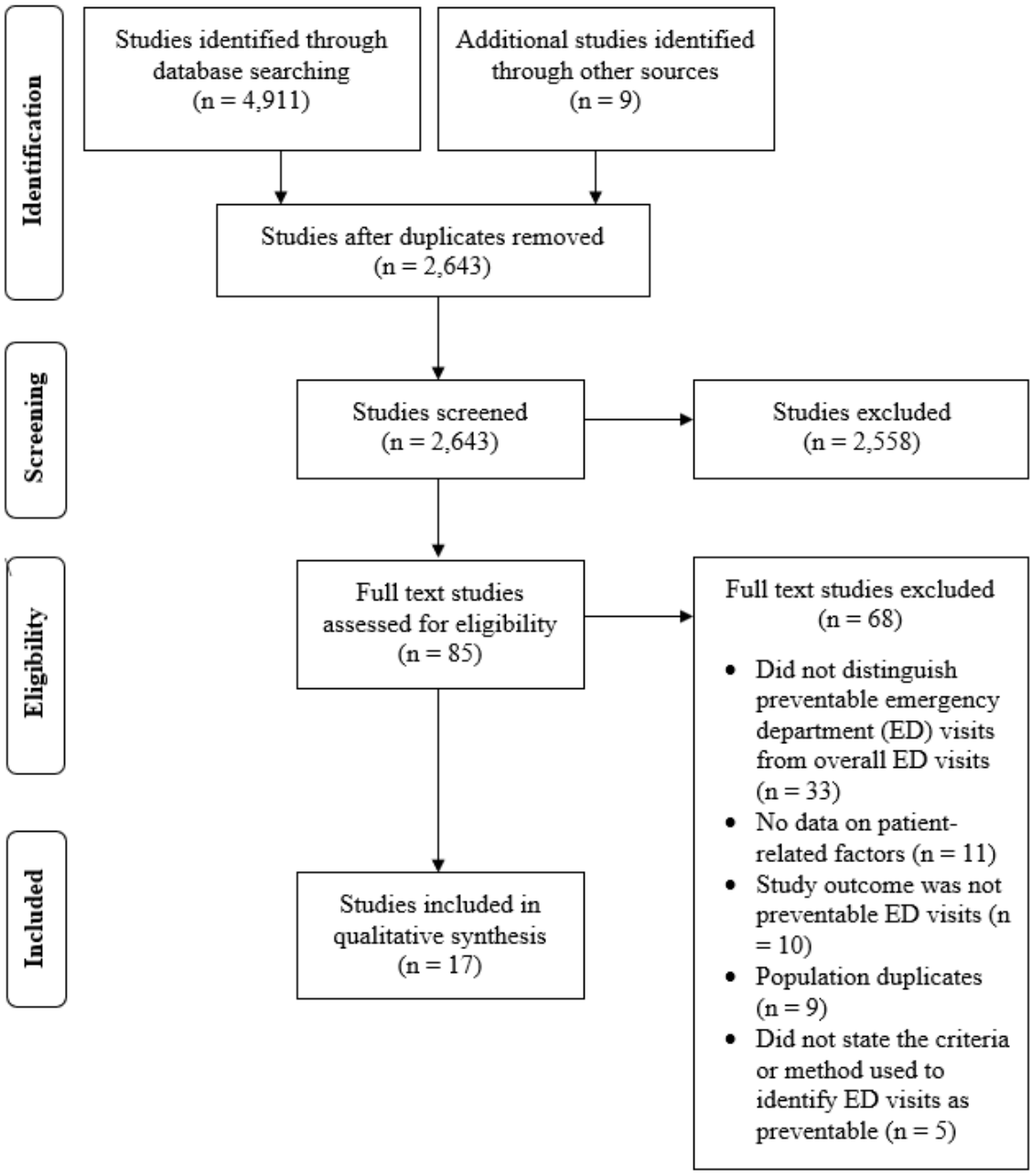

Figure 2.1: PRISMA diagram of study selection and screening

2.4.2 Study and Population Characteristics

The characteristics of the included studies are summarized in Table 2.1. Fifteen of the 17 studies were peer-reviewed studies [36-50], one was a health report published by the Canadian Institute for Health Information (CIHI) [51], and one was a conference abstract [52]. Nine studies were cross-sectional studies that used data from patient surveys and questionnaires that were administered in hospital EDs [36, 39, 40, 42, 46-49, 52], and four studies were cross-sectional population-based studies [38, 45, 50, 51]. Two studies were health records reviews [43, 44], and two studies were population-based retrospective cohort studies [37, 41]. In terms of the population characteristics, most of the studies investigated the general adult population. Three studies specifically investigated preventable ED visits among the senior adult population (age ≥ 65 years) [40, 41, 43]. Gruneir *et al.* specifically investigated the senior adult population living in long term care (LTC) facilities [41], while Goodridge *et al.* and Hendin *et al.* broadly investigated the senior adult population [40, 43]. The CIHI report also included findings from the general adult population, the community-dwelling senior adult population, and the senior adult population living in LTC facilities [51].

Table 2.1: Summary of study and population characteristics, criteria, and prevalence of preventable ED visits

Author (Year)	Location of study	Study Design	Study Setting	Population	Criteria for preventable ED visits	Prevalence of preventable ED visits (%)
Afilalo *et al.* (2004) [36]	Québec	Cross-sectional	Hospital	General adults	CTAS V	25.0%
Alsabbagh *et al.* (2019) [37]	Ontario	Retrospective cohort	Population-based	General adults	FPSC and CTAS ≥ IV	12.4%
					Subset of FPSC diagnoses and CTAS ≥ IV	4.3%
Altmayer *et al.* (2005) [38]	Ontario	Cross-sectional	Population-based	General adults	SNC	7.2%
CIHI (2014) [51]	Ontario, Alberta, Nova Scotia, Saskatchewan, Prince Edward Island, Yukon[a]	Cross-sectional	Population-based	(1) General adults	FPSC	21.0%
	Ontario, Alberta, Yukon			(2) Community-dwelling senior adults	ACSC	16.0%

					CTAS ≥ IV	25.0%
	Ontario, Alberta, Yukon			(3) Senior adults in LTC facilities	ACSC	24.0%
					CTAS ≥ IV	10.0%
Field *et al.* (2006) [39]	Nova Scotia	Cross-sectional	Hospital	General adults	CTAS ≥ IV	NA
Goodridge *et al.* (2019) [40]	Saskatchewan	Cross-sectional	Hospital	Senior adults	CTAS ≥ IV	NA
Gruneir *et al.* (2010) [41]	Ontario	Retrospective cohort	Population-based	Senior adults in LTC facilities	ACSC	25.4%
					CTAS ≥ IV	10.6%
Han *et al.* (2007) [42]	Alberta	Cross-sectional	Hospital	General adults	CTAS ≥ II	NA
Hendin *et al.* (2018) [43]	Ontario	Health records review	Hospital	Senior adults	CTAS ≥ IV	NA
Jones *et al.* (2015) [44]	Ontario	Health records review	Family health team	General adults	CTAS ≥ IV	24.0%
Khan *et al.* (2011) [45]	Ontario	Cross-sectional	Population-based	General adults	CTAS ≥ IV	59.1%

Krebs *et al.* (2017) [46]	Alberta	Cross-sectional	Hospital	General adults	CTAS ≥ III	NA
MacKay *et al.* (2017) [47]	New Brunswick	Cross-sectional	Hospital	General adults	CTAS ≥ IV	NA
Sancton *et al.* (2018) [48]	British Columbia	Cross-sectional	Hospital	General adults	CTAS (level not specified)	NA
Steele *et al.* (2008) [49]	Ontario	Cross-sectional	Hospital	General adults	CTAS ≥ IV	NA
VanStone *et al.* (2014) [50]	Ontario	Cross-sectional	Population-based	General adults	CTAS ≥ IV	47.3%
Woolfrey *et al.* (2011) [52]	Ontario	Cross-sectional	Hospital	General adults	CTAS ≥ III	NA

ACSC: ambulatory care sensitive condition; CIHI: Canadian Institute for Health Information; CTAS: Canadian Triage and Acuity Scale; ED: emergency department; FPSC: family practice sensitive condition; LTC: long term care; NA: not applicable; SNC: sentinel non-urgent condition

[a] Only facilities that submitted ED data with complete diagnosis codes to CIHI were included: Ontario (all facilities), Alberta (all facilities), Nova Scotia (five facilities), Saskatchewan (four facilities), Prince Edward Island (one facility), and Yukon (one facility).

2.4.3 Criteria and Methods Used to Identify Preventable ED Visits

Our systematic review found four types of criteria that were used to identify preventable ED visits: the Canadian Triage and Acuity Scale (CTAS), family practice sensitive conditions (FPSCs), ambulatory care sensitive conditions (ACSCs), and sentinel non-urgent conditions (SNCs) (Table 2.1). CTAS is a triage system used in Canadian EDs to assess patients' acuity and need for medical intervention and is composed of five levels: I (resuscitation), II (emergent), III (urgent), IV (less urgent), and V (non-urgent) [53]. ACSCs, FPSCs, and SNCs are lists of conditions and diagnoses that are identified using International Classification of Diseases (ICD) codes [54-56]. ACSCs are conditions for which timely and effective primary healthcare could prevent or reduce the risk of hospitalization by either preventing the onset of the illness, controlling the acute illness episode, or managing a chronic condition or disease [54]. While they were originally developed to identify preventable hospitalizations, the studies in our systematic review specifically used a list of ACSCs that had been validated for the LTC population to identify preventable ED visits [41, 51]. FPSCs are ED visits for conditions that could be appropriately managed at a family physician's (FP) office, based on diseases or conditions that were the cause of Alberta ED or urgent care visits in 2006-2007 and for which the probability of admission as an inpatient was less than 1% [55]. SNCs are ED visits for conditions that may be treated in alternative primary care settings among the population between ages 1 to 74, and excludes ED visits that were triaged as CTAS I-III, scheduled or planned ED visits, or ED visits that resulted in inpatient admission [56]. These criteria are described in further detail in Appendix D.

Overall, CTAS was most commonly used to identify preventable ED visits; however, studies varied in which levels were included when categorizing the visits. Ten studies categorized ED visits as preventable if they were triaged as CTAS ≥ IV [39-41, 43-45, 47, 49-51], whereas two studies categorized ED visits as preventable if they were triaged as CTAS ≥ III [46, 52]. Afilalo *et al.* only considered ED visits that were triaged as CTAS V to be preventable [36], while Han *et al.* included those that were triaged as CTAS ≥ II [42] and Sancton *et al.* did not specify which CTAS levels were included [48]. Alsabbagh *et al.* identified preventable ED visits in two different ways [37]. First, they

identified ED visits that were triaged as CTAS ≥ IV and the reason for the visit (the most clinically significant diagnosis, condition, problem or circumstance for the patient's visit) was listed as a FPSC [37]. Then, within these visits they identified those that were diagnosed with a subset of FPSCs that could be potentially managed by pharmacists within an expanded scope of practice [37]. Gruneir *et al.* had two categories of preventable ED visits: ED visits for which the reason for the visit was listed as an ACSC (from a list of ACSCs that had been validated for the LTC population) and ED visits that were triaged as CTAS ≥ IV [41]. For the general adult population, the CIHI report identified preventable ED visits as those that listed a FPSC as the reason for the visit [51]. For the senior adult population, they had two categories: ED visits for which the reason for the visit was listed as an ACSC (from a list of ACSCs that had been validated for the LTC population) and ED visits that were triaged as CTAS ≥ IV [51]. Altmayer *et al.* identified preventable ED visits as those that listed a SNC as the reason for the visit [38].

2.4.4 Prevalence of Preventable ED Visits

For the general adult population, the prevalence of preventable ED visits ranged from 4.3% to 59.1% with a median (based on the estimates reported from the included studies) of 22.5% (Table 2.1). For the senior adult population, the prevalence ranged from 10.0% to 25.4% with a median of 20.0%. The studies that reported estimates of 22.5% or higher [36, 41, 44, 45, 50, 51] primarily used CTAS to identify preventable ED visits, whereas the studies that reported estimates of less than 22.5% [37, 38, 41, 51] primarily used ICD-based lists of diagnoses (ACSCs, FPSCs, or SNCs) to determine whether the ED visit was preventable.

2.4.5 Patient-related Factors

We categorized the patient-related factors into three groups: (1) access to primary healthcare, (2) sociodemographic characteristics, and (3) patient health status.

2.4.5.1 Access to Primary Healthcare

Factors related to access to primary healthcare included patients having a source of primary healthcare, prior healthcare use, reasons for the ED visit, and sources of referral to the ED (Table 2.2). Most patients reported having a source of primary healthcare, with the most common sources being a FP, general practitioner (GP) or a walk-in clinic. Three studies found that approximately 50% to 60% of patients who had a preventable ED visit attempted to access at least one other source of care before presenting to the ED, with the most common source being a FP or walk-in clinic [42, 46, 48]. While Alsabbagh *et al.* found that having a FP was associated with higher odds of having a preventable ED visit (AOR = 1.26, 95% CI 1.25-1.27), this was in the context of presenting to the ED with a condition that could be potentially managed by pharmacists within an expanded scope of practice [37]. In comparison, Khan *et al.* found that, in the context of having a less urgent ED visit that was triaged as CTAS ≥ IV, those who reported having a regular medical doctor had lower odds of having a preventable ED visit (AOR = 0.75, 95% CI 0.56-0.93) [45]. They also found that fewer visits to a FP or GP were associated with lower odds of having a preventable ED visit (AOR = 0.63, 95% CI 0.52-0.73) [45].

In addition, five key factors played a role in patients' decisions to visit the ED: barriers to primary healthcare, perceived urgency of their symptoms, need for immediate care, negative perceptions or experiences with primary healthcare, and relatively positive perceptions regarding the accessibility and quality of care provided in EDs. Common barriers to primary healthcare included patients being unable to contact their PCP, their PCP's office was closed, or they were unable to obtain an appointment in a timely manner. Patients also felt that they required immediate medical attention for their concerns or that they required a specific test or service that could be obtained in EDs. These feelings of needing care and being unable to access primary healthcare were coupled with more positive views of EDs in terms of convenience and level of care. Patients felt that EDs were more convenient locations to receive medical attention since they provided around-the-clock care and access to various medical and diagnostic services at a single location. Three studies found that more than 87% of patients who had a preventable ED visit believed that the ED was the best option or place to obtain care

[42, 46, 48]. As well, patients described feelings of confidence, familiarity, and trust in EDs, and that they could receive more rapid, thorough, and higher quality of care in EDs than from their PCP.

Table 2.2: Summary of study findings for associations between preventable ED visits and access to primary healthcare

Author (Year)	Having a source of primary healthcare	Prior healthcare use	Reasons for ED visit	Referral source to ED
Afilalo *et al.* (2004) [36]	There was no statistically significant difference in being followed up by a PCP between patients who had a preventable or non-preventable ED visit (69.8% vs. 75.2%, p = 0.1576).	Patients who had a preventable ED visit had fewer hospital admissions in the past three years than those who had a non-preventable ED visit (mean [SD] of 0.66 [1.76] vs. 1.13 [2.51], p = 0.0296).	Among those who had a PCP, commonly reported reasons for why they visited the ED instead of their PCP included: accessibility (32.1%), need (22.1%), referral or follow-up (20.2%), familiarity (11.1%), or trust (7.4%). Accessibility referred to their PCP's office being closed, unable to contact PCP, or unable to obtain an appointment with their PCP.	
Alsabbagh *et al.* (2019) [37]	In the context of presenting to the ED with a condition that could be potentially managed by pharmacists within an expanded scope of practice, 86.8% of patients who had a preventable ED visit had access to a FP. Having a FP was associated with higher odds of having a preventable ED visit (AOR = 1.26, 95% CI 1.25-1.27).			

Altmayer *et al.* (2005) [38]				
CIHI (2014) [51]				
Field *et al.* (2006) [39]	84% of patients who had a preventable ED visit reported having a FP. No patient reported being unable to find a FP who was accepting new patients.	65% of patients who had a preventable ED visit reported that the ED was the first care site attended.	Commonly reported reasons included: needing a specific service (49%), needing urgent treatment (43%), limited access to their FP (23%), referred to ED (20%), could not wait for an appointment with their FP (15%), or FP's office was closed (4%).	Most common sources of referral to the ED were a FP (28%) or walk-in clinic (12%).
Goodridge *et al.* (2019) [40]			For senior adult patients (ages 65 or older), commonly reported reasons included: accessibility, availability, perceived quality of care, satisfactory experiences with ED care in the past, and being able to access comprehensive medical, diagnostic, and multidisciplinary services in a single location.	For senior adult patients (ages 65 or older), the decision to visit the ED was primarily made by the patient or a family member (68.7%). 16.5% said they were referred by a GP, and 14.8% said they were referred by a specialist.

Gruneir *et al.* (2010) [41]		Among senior adult patients (ages 65 or older) living in LTC facilities, 13% of those who had a preventable ED visit had seen a physician at the LTC facility on the day of their ED visit.	
Han *et al.* (2007) [42]	79% of patients who had a preventable ED visit had a FP.	61% of patients attempted to access at least one source of alternative care before presenting to the ED. The most common source of alternative care attempted was a physician. As well, 89% of patients believed that the ED was their best option for care.	Commonly reported reasons included: perceived severity of problem, quality of care in ED, physician availability, professional referral, perceived rapid care in ED, and convenience.
Hendin *et al.* (2018) [43]	91.1% of senior adult patients (ages 65 or older) had a FP.		
Jones *et al.* (2015) [44]			
Khan *et al.* (2011) [45]	Having a regular medical doctor was associated with lower odds of having a preventable ED visit (AOR = 0.75, 95% CI 0.56-0.93).	Fewer visits to a FP or GP (1-4 visits vs. > 4 visits) were associated with lower odds of having a preventable ED visit (AOR = 0.63, 95% CI 0.52-0.73). As well, fewer visits to a specialist (1-4 visits vs. > 4 visits) were associated with lower odds of having a	

		preventable ED visit (AOR = 0.67, 95% CI 0.58-0.77).	
Krebs *et al.* (2017) [46]	74.4% of patients who had a preventable ED visit had a FP.	60.1% of patients attempted to access at least one source of alternative care before presenting to the ED. The most common source of alternative care was a family doctor or a walk-in clinic doctor. 89.3% of patients believed that the ED was their best option for care.	Commonly reported reasons included: safety, perceived severity of their health problem, effectiveness and efficiency of EDs in terms of treating their health problem and being cost-saving from the patients' perspective, limited access to their FP, convenience of EDs as a "one-stop shop" for their health needs, and trust.
MacKay *et al.* (2017) [47]	23.4% of patients had a PCP.	Among patients who had a preventable ED visit and reported having a PCP, 46% attempted to call their PCP prior to presenting to the ED.	Commonly reported reasons included: felt that their condition required a specific diagnostic test or service that could be obtained in EDs (45%) or wait time to see their PCP was too long (36%).
Sancton *et al.* (2018) [48]	72.4% of patients who had a preventable ED visit had a FP.	50% of patients attempted to access at least one source of alternative care before presenting to the ED. The most common source of alternative care was a FP or walk-in clinic. 87.6% of patients believed that the ED was the best place to obtain care.	

Steele *et al.* (2008) [49]	89.1% of patients who had a preventable ED visit had a FP.	38.7% of patients who had a preventable ED visit had seen a FP about their problem before.	Commonly reported reasons included: needing treatment as soon as possible (38.7%), needing a specific service that was offered in the ED (32.8%), FP's office was closed (21.9%), or could not wait for an appointment with their FP (16.8%).	30.7% of patients who had a preventable ED visit were referred to the ED. The most common referral source was the patients' FP or a healthcare worker.
VanStone *et al.* (2014) [50]	A greater proportion of patients in the most materially and socially deprived population quintile did not have a PCP, compared to the least deprived population quintile (20% vs. 5%).			
Woolfrey *et al.* (2011) [52]	85.2% of patients who had a preventable ED visit had a FP.		Commonly reported reasons included: felt that FP could not deal with their current medical concern (59.7%) or felt that their concern was urgent or life-threatening (43.5%).	

ACSC: ambulatory care sensitive condition; AOR: adjusted odds ratio; CI: confidence interval; CIHI: Canadian Institute for Health Information; CTAS: Canadian Triage and Acuity Scale; ED: emergency department; FP: family physician; GP: general practitioner; LTC: long term care; PCP: primary care provider; SD: standard deviation

2.4.5.2 Sociodemographic Characteristics

Sociodemographic characteristics evaluated in the studies included patients' age, education level, employment status, ethnicity, immigration status, income, living arrangements, marital status, rurality, sex, and sexual orientation (Table 2.3). Preventable ED visits were associated with low education level (did not complete secondary school) (AOR = 1.65, 95% CI 1.35-1.94) [45], low household income (≤ $59,999) (AOR = 1.42, 95% CI 1.23-1.62) [45], and living in rural areas (AOR = 1.72, 95% CI 1.47-2.04) [45]. Patients who had a preventable ED visit were generally younger, and older age (≥ 65 years) was associated with lower odds of having a preventable ED visit (AOR = 0.61, 95% CI 0.44-0.83) [44]. Most of the studies reported that a larger proportion of patients who had a preventable ED visit were female. There were, however, conflicting results in the regression analyses; Alsabbagh *et al.* reported that females had higher odds of having a preventable ED visit (AOR = 1.23, 95% CI 1.23-1.24) [37], whereas Khan *et al.* found that males had higher odds of having a preventable ED visit (AOR = 1.33, 95% CI 1.14-1.52) [45] and Jones *et al.* found no significant association between males and preventable ED visits (AOR = 0.98, 95% CI 0.78-1.25) [44]. It should be noted, however, that Khan *et al.* and Jones *et al.* both identified preventable ED visits as those that were triaged as CTAS ≥ IV [44, 45], while Alsabbagh *et al.* identified preventable ED visits as those that were triaged as CTAS ≥ IV and diagnosed with a subset of FPSCs that could be potentially managed by pharmacists within an expanded scope of practice [37]. No regression analyses were conducted for employment status, ethnicity, immigration status, living arrangements, marital status, and sexual orientation, so we were unable to determine if there was an association between these characteristics and preventable ED visits.

Table 2.3: Summary of study findings for associations between preventable ED visits and sociodemographic characteristics

Author (Year)	Age	Education level	Employment status	Ethnicity	Immigration status	Income
Afilalo *et al.* (2004) [36]	Patients who had a preventable ED visit were younger than those who had a non-preventable ED visit (mean [SD] age of 43.3 years [18.1] vs. 48.7 years [20.1], p = 0.0146).	There was no statistically significant difference between patients who had a preventable or non-preventable ED visit in their education level (31.0% of patients who had a preventable ED visit had an education level beyond secondary school vs. 28.0% of patients who had a non-preventable ED visit, p = 0.3806).	There was no statistically significant difference between patients who had a preventable or non-preventable ED visit in their employment status (55.9% of patients who had a preventable ED visit reported working as their primary source of income vs. 48.3% of patients who had a non-preventable ED visit, p = 0.0891).		There was no statistically significant difference between patients who had a preventable or non-preventable ED visit in their immigration status (24.1% of patients who had a preventable ED visit were not born in Canada vs. 20.1% of patients who had a non-preventable ED visit, p = 0.5818).	

Alsabbagh *et al.* (2019) [37]	Patients who had a preventable ED visit were younger than those who had a non-preventable ED visit (mean [SD] age of 31 years [22.4] vs. 37 years [23.7], $p < 0.01$). Older age was associated with lower odds of having a preventable ED visit.	22.5% of patients who had a preventable ED visit lived in the lowest patient neighbourhood income quintile, compared to 16.8% in the highest quintile. Living in an area with a higher patient neighbourhood income quintile was associated with lower odds of having a preventable ED visit.
Altmayer *et al.* (2005) [38]		
CIHI (2014) [51]	Among the general adult population, patients who had a preventable ED visit were generally younger (30% less than 18 years vs. 36% between ages 18 to 44 years vs.	Among the general adult population, 65% of patients who had a preventable ED visit lived in the low, low-to-medium, and medium income quintiles.

	22% between ages 45 to 64 years vs. 12% ages 65 or older).					
Field *et al.* (2006) [39]						
Goodridge *et al.* (2019) [40]	Among senior adult patients (ages 65 or older), the mean age (range) was 79.1 years (65-98).					
Gruneir *et al.* (2010) [41]						
Han *et al.* (2007) [42]	Mean age [SD] was 44.1 years [19.7].	42% of patients who had a preventable ED visit had an education level of secondary school or less.	52% of patients who had a preventable ED visit reported being unemployed over the past 12 months.	71% of patients who had a preventable ED visit were white.		Mean household income [SD] was $61,700 [$24,200].

Hendin *et al.* (2018) [43]	Among senior adult patients (ages 65 or older), the mean age [SD] was 76.5 years [9.3].		
Jones *et al.* (2015) [44]	Patients who had a preventable ED visit were younger than those who had a non-preventable ED visit (mean age of 38.9 years vs. 45.9 years). Older age (≥ 65 years) was associated with lower odds of having a preventable ED visit (AOR = 0.61, 95% CI 0.44-0.83).		
Khan *et al.* (2011) [45]	Older age was associated with lower odds of having a preventable ED visit (AOR = 0.97, 95% CI 0.97-0.98) and higher odds of	Low education level (did not complete secondary school) was associated with higher odds of having a preventable ED	Low household income (≤ $59,999) was associated with higher odds of having a preventable ED visit (AOR = 1.42, 95% CI 1.23-1.62).

	having a non-preventable ED visit (AOR = 1.02, 95% CI 1.01-1.03).	visit (AOR = 1.65, 95% CI 1.35-1.94).		
Krebs *et al.* (2017) [46]	Mean age [SD] was 45.2 years [19.8].	46.6% of patients who had a preventable ED visit had an education level of secondary school or less.	44.5% of patients who had a preventable ED visit reported being unemployed.	71.8% of patients who had a preventable ED visit were Caucasian or European.
MacKay *et al.* (2017) [47]	Mean age (range) was 38.5 years (0-90).	40% of patients who had a preventable ED visit had an education level of secondary school or less.	50% of patients who had a preventable ED were employed.	
Sancton *et al.* (2018) [48]	Mean age [SD] was 42.7 years [17.1].	29.0% of patients who had a preventable ED visit had an education level of secondary school or less.	74.1% of patients who had a preventable ED visit reported their primary activity as either working, in	

		school, or retired. 17.4% reported being unemployed or disabled.
Steele *et al.* (2008) [49]		
VanStone *et al.* (2014) [50]	In the most materially and socially deprived population quintile, the peak volume of preventable ED visits was at the age of 17, where males comprised a greater proportion of these visits. In the least deprived population quintile, there was a greater proportion of preventable ED visits among females in their early 20s.	

Woolfrey *et al.* (2011) [52]	Mean age [SD] was 40 years [17.3].	54.1% of patients who had a preventable ED visit had some college or university education.

Table 2.3 ***(continued)***

Author (Year)	Living arrangements	Marital status	Geography	Sex	Sexual orientation
Afilalo *et al.* (2004) [36]	There was no statistically significant difference between patients who had a preventable or non-preventable ED visit in their living arrangements (15.0% of patients who had a preventable ED visit lived alone vs. 19.2% of patients who had a non-preventable ED visit, p = 0.0458).			There was no statistically significant difference between patients who had a preventable or non-preventable ED visit in terms of sex distribution (50.7% of patients who had a preventable ED visit were female vs. 49.3% of patients who had a non-preventable ED visit, p = 0.8018).	
Alsabbagh *et al.* (2019) [37]				A larger proportion of patients who had a preventable ED visit were female, compared to those	

		who had a non-preventable ED visit (55.4% vs. 49.4%, p < 0.0001). Females had higher odds of having a preventable ED visit (AOR = 1.23, 95% CI 1.23-1.24).
Altmayer *et al.* (2005) [38]	Age-standardized rate of preventable ED visits ranged from 895 visits per 100,000 population in urban counties to 22,455 visits per 100,000 population in rural counties. The comparative rate ratio (county-specific rate over provincial rate) ranged from 0.3 for urban counties to 7.1 in rural counties.	
CIHI (2014) [51]	Among the general adult population, 41% of preventable ED visits were made by patients of rural residence.	Among the general adult population, 52% of patients who had a preventable ED visit were female. Among the senior adult (ages 65 or older) population living in LTC facilities, the

		Among the senior adult (ages 65 or older) population living in LTC facilities, the proportion of preventable ED visits made by rural patients was 10% (if identified using ACSCs) or 37% (if identified using CTAS). Among the community-dwelling senior adult population, the proportion of preventable ED visits made by rural patients was 21% (if identified using ACSCs) or 43% (if identified using CTAS).	proportion of preventable ED visits made by female patients was 62% (if identified using ACSCs) or 65% (if identified using CTAS). Among the community-dwelling senior adult population, the proportion of preventable ED visits made by female patients was 55% (if identified using ACSCs) or 52% (if identified using CTAS).
Field *et al.* (2006) [39]		92% of patients were residents of the regional municipality	

			where the ED was located.		
Goodridge *et al.* (2019) [40]				Among senior adult patients (ages 65 or older), 59.1% of patients who had a preventable ED visit were female.	
Gruneir *et al.* (2010) [41]					
Han *et al.* (2007) [42]	77% of patients who had a preventable ED visit lived with someone else. As well, 98% of patients lived in non-assisted residences (i.e. private dwellings).	52% of patients who had a preventable ED visit were not married.		51% of patients who had a preventable ED visit were female.	97% of patients who had a preventable ED visit were heterosexual.
Hendin *et al.* (2018) [43]	12.9% of the senior adult patients (ages 65 or older) came to the ED from a retirement home or nursing home.			Among senior adult patients (ages 65 or older), 56.6% of patients who had a preventable ED visit were female.	
Jones *et al.* (2015) [44]				There was no statistically significant association between sex and having a preventable ED visit (AOR = 0.98, 95% CI 0.78-1.25).	

Khan *et al.* (2011) [45]			Rural residence was associated with higher odds of having a preventable ED visit (AOR = 1.72, 95% CI 1.47-2.04).	Males had higher odds of having a preventable ED visit (AOR = 1.33, 95% CI 1.14-1.52).	
Krebs *et al.* (2017) [46]	75.5% of patients who had a preventable ED visit lived with someone else. As well, 93.0% of patients lived in non-assisted residences (i.e. private dwellings).	53.9% of patients who had a preventable ED visit were not married.		54.8% of patients who had a preventable ED visit were female.	95.1% of patients who had a preventable ED visit were heterosexual.
MacKay *et al.* (2017) [47]				46% of patients who had a preventable ED visit were female.	
Sancton *et al.* (2018) [48]	28.2% of patients who had a preventable ED visit lived alone. As well, 87.1% of patients lived in non-assisted residences (i.e. private dwellings).	55.2% of patients who had a preventable ED visit were not married.		51.1% of patients who had a preventable ED visit were female.	
Steele *et al.* (2008) [49]			79.6% of patients said they were		

	residents of the hospital's nearby rural area.	
VanStone *et al.* (2014) [50]		
Woolfrey *et al.* (2011) [52]		53.7% of patients who had a preventable ED visit were female.

ACSC: ambulatory care sensitive condition; AOR: adjusted odds ratio; CIHI: Canadian Institute for Health Information; CI: confidence interval; CTAS: Canadian Triage and Acuity Scale; ED: emergency department; LTC: long term care; SD: standard deviation

2.4.5.3 Patient Health Status

Factors related to patient health status examined in the studies included patients' medical history, functional ability, health behaviours, perceived severity of their current medical concern, and self-rated health (Table 2.4). There was a strong association between self-rated health and preventable ED visits, with those who perceived their health as fair or poor being more likely to have a preventable ED visit (AOR = 1.80, 95% CI 1.41-2.19) [45]. In general, patients who had a preventable ED visit had higher functional ability in terms of performing daily activities, walking, and self-care. Patients who had a preventable ED visit generally waited longer before presenting to the ED, with Afilalo *et al.* reporting an average of 12.4 hours for preventable ED visits compared to 5.4 hours for non-preventable ED visits [36]. Patients with two or more chronic conditions were more likely to visit the ED at least once (RR = 1.44, 95% CI 1.34-1.54), and their visits were more likely to be non-preventable (RR = 1.30, 95% CI 1.16-1.44) [45]. No regression analyses were conducted for health behaviours, which included alcohol consumption, smoking, drug use, and having an influenza shot.

Table 2.4: Summary of study findings for associations between preventable ED visits and patient health status

Author (Year)	Medical history	Functional ability	Health behaviours	Perceived severity of current medical concern	Self-rated health
Afilalo *et al.* (2004) [36]	Patients who had a preventable ED visit had fewer prior medical conditions than those who had a non-preventable ED visit (mean [SD] of 3.13 [3.09] vs. 3.88 [3.43], p = 0.0231).	Patients who had a preventable ED visit had slightly higher functional ability than those who had a non-preventable ED visit (from a scale of 1 to 3 increasing functional ability, mean [SD] of 2.92 [0.19] vs. 2.87 [0.29], p = 0.0131).		Patients who had a preventable ED visit perceived their symptoms to be less severe than those who had a non-preventable ED visit (from a scale of 1 to 4 increasing severity, mean [SD] of 3.06 [0.88] vs. 3.28 [0.77], p = 0.0067). In the multivariate analyses, perceived severity of illness was significantly associated with preventable ED visits. Patients who had a preventable ED visit waited longer with their symptoms before visiting the ED (12.4 hours vs. 5.4 hours for those who had a non-preventable ED visit).	Patients who had a preventable ED visit reported higher self-rated health than those who had a non-preventable ED visit (from a scale of 1 to 4 better health, mean [SD] 3.08 [0.91] vs. 2.87 [0.93], p = 0.0160).

Alsabbagh *et al.* (2019) [37]			
Altmayer *et al.* (2005) [38]			
CIHI (2014) [51]			
Field *et al.* (2006) [39]		56% of patients who had a preventable ED visit reported having their medical condition for less than 48 hours.	
Goodridge *et al.* (2019) [40]	Among senior adult patients (ages 65 or older), 33.9% required assistance in their self-care.	Among senior adult patients (ages 65 or older), 78.3% attempted to manage their symptoms on their own through rest, comfort measures, or previously prescribed medication before visiting the ED.	Among senior adult patients (ages 65 or older), 40.9% rated their health as fair or poor
Gruneir *et al.* (2010) [41]			

Han *et al.* (2007) [42]			37% of patients who had a preventable ED visit were current smokers.	
Hendin *et al.* (2018) [43]	Patients ages 65 or older had more complex medical histories – common conditions included hypertension (51.1%), musculoskeletal disorder (24.0%), heart disease (18.3%), diabetes (15.7%), dementia (10.9%), and/or lung disease (10.9%).			
Jones *et al.* (2015) [44]				
Khan *et al.* (2011) [45]	Patients who had ≥ 2 chronic conditions were more likely to visit the ED (RR = 1.44, 95% CI 1.34-1.54), and their visits were more likely to be	Patients with disabilities were more likely to visit the ED (RR = 1.54, 95% CI 1.41-1.67), and their visits were		Fair or poor self-rated health was associated with higher odds of having a preventable ED visit (AOR = 1.80, 95% CI 1.41-2.19).

	non-preventable (RR = 1.30, 95% CI 1.16-1.44).	more likely to be non-preventable (RR = 1.27, 95% CI 1.13-1.41).		
Krebs *et al.* (2017) [46]			56.7% of patients who had a preventable ED visit consumed alcohol; 31.5% were current smokers; 12.0% reported drug use other than alcohol or smoking; and 33.1% had an influenza shot in the past year.	
MacKay *et al.* (2017) [47]				
Sancton *et al.* (2018) [48]		81.7% of patients who had a preventable ED visit were able to walk ≥ 2 blocks.	26.4% of patients who had a preventable ED visit were current smokers.	34.7% of patients who had a preventable ED visit waited < 48 hours before presenting to the ED, while 31.2% waited between two to

	seven days before presenting to the ED.
Steele *et al.* (2008) [49]	51.1% of patients who had a preventable ED visit reported having their immediate medical concern for > 48 hours before presenting to the ED.
VanStone *et al.* (2014) [50]	
Woolfrey *et al.* (2011) [52]	

AOR: adjusted odds ratio; CI: confidence interval; CIHI: Canadian Institute for Health Information; ED: emergency department; RR: rate ratio; SD: standard deviation

2.4.6 Results of Risk of Bias Assessment

Tables 2.5 and 2.6 presents the results from the risk of bias assessment. For the purpose of the risk of bias assessment, the health records reviews [43, 44] were assessed as cross-sectional studies. Six of the 15 peer-reviewed studies were classified as low risk of bias [36, 37, 42, 44-46], six studies were classified as moderate risk of bias [38, 40, 41, 43, 48, 50], and three were classified as high risk of bias [39, 47, 49]. For the cohort studies, Alsabbagh *et al.* had a low risk of bias [37], while Gruneir *et al.* had a moderate risk of bias [41]. Five of the cross-sectional studies had a low risk of bias [36, 42, 44-46], five had a moderate risk of bias [38, 40, 43, 48, 50], and three had a high risk of bias [39, 47, 49]. Therefore, the overall risk of bias was moderate-to-low.

Most of the studies underperformed in the selection and comparability domains. For the selection domain, many of the cross-sectional studies did not compare the characteristics of the respondents and non-respondents. For the comparability domain, most of the studies did not control for potential confounding factors.

Table 2.5: Summary of risk of bias assessment for cross-sectional studies (n = 13)

		Selection (Max. 5 points)				**Comparability** (Max. 2 points)	**Outcome** (Max. 3 points)		
Author (Year)	**Study Design**	**1. Representativeness of the sample** (Max. 1 point)	**2. Sample size** (Max. 1 point)	**3. Non-respondents** (Max. 1 point)	**4. Ascertainment of the exposure** (Max. 2 points)	**1. Based on the study design or analysis** (Max. 2 points)	**1. Assessment of outcome** (Max. 2 points)	**2. Statistical test** (Max. 1 point)	**Total (/10)**
Afilalo *et al.* (2004) [36]	Cross-sectional	+		+	+	++	++	+	8
Altmayer *et al.* (2005) [38]	Cross-sectional	+	+		++		++		6
Field *et al.* (2006) [39]	Cross-sectional	+			+		+		3
Goodridge *et al.* (2019) [40]	Cross-sectional	+	+		+		+		4
Han *et al.* (2007) [42]	Cross-sectional	+	+		++	++	+	+	8

Hendin *et al.* (2018) [43]	Cross-sectional	+			+		++	+	5
Jones *et al.* (2015) [44]	Cross-sectional	+	+	+	++	++	++	+	10
Khan *et al.* (2011) [45]	Cross-sectional	+	+		++	++	++	+	9
Krebs *et al.* (2017) [46]	Cross-sectional	+	+		+	++	+	+	7
MacKay *et al.* (2017) [47]	Cross-sectional	+			+		+		3
Sancton *et al.* (2018) [48]	Cross-sectional	+	+		++		+	+	6
Steele *et al.* (2008) [49]	Cross-sectional	+			+		+		3
VanStone *et al.* (2014) [50]	Cross-sectional	+	+		+		++		5

Table 2.6: Summary of risk of bias assessment for cohort studies (n = 2)

		Selection (Max. 4 points)				**Comparability** (Max. 2 points)	**Outcome** (Max. 3 points)			
Author (Year)	**Study Design**	**1. Representativeness of the exposed cohort** (Max. 1 point)	**2. Selection of the non-exposed cohort** (Max. 1 point)	**3. Ascertainment of exposure** (Max. 1 point)	**4. Demonstration that outcome of interest was not present at start of study** (Max. 1 point)	**1. Based on design or analysis** (Max. 2 points)	**1. Assessment of outcome** (Max. 1 point)	**2. Follow-up long enough for outcomes to occur** (Max. 1 point)	**3. Adequacy of follow up** (Max. 1 point)	**Total (/9)**
Alsabbagh *et al.* (2019) [37]	Cohort	+	+	+	+	++	+	+		8
Gruneir *et al.* (2010) [41]	Cohort	+	+	+	+		+		+	6

2.5 Discussion

We conducted a systematic review to explore the prevalence of preventable ED visits among adults in Canada and the patient-related factors associated with these visits. Across the 17 studies that were included in this systematic review, the prevalence ranged from 4.3% to 59.1%, with a median prevalence of 22.5% for the general adult population. For the senior adult population, the prevalence ranged from 10.0% to 25.4%, with a median of 20.0%. CTAS was most commonly used to identify preventable ED visits although studies varied in which levels were included. Other criteria that were also used included ACSCs, SNCs, and FPSCs. Majority of patients who had a preventable ED visit reported having a source of primary healthcare but chose to visit the ED due to being unable to access their PCP. Their decision to visit the ED was also driven by the perceived severity of their symptoms and need for immediate care, coupled with the convenience, accessibility, and perceived higher quality of care provided in EDs compared to primary care settings. Preventable ED visits were associated with younger age, low education level, low income, rural residence, and worse self-rated health. Other factors that were explored but had no reported associations included employment status, ethnicity, health behaviours, immigration status, living arrangements, marital status, and sexual orientation.

While the risk of bias for most of the individual studies was moderate-to-low, the overall strength of evidence was limited due to many of them being cross-sectional studies, which are limited in their ability to establish causal inferences. As well, the strength of evidence was limited because most of the studies only reported the descriptive statistics of the patient-related factors and only four studies [36, 37, 44, 45] conducted regression analyses to assess the associations between these factors and preventable ED visits while controlling for other variables.

Despite these limitations in our strength of evidence, our results are consistent with findings from previous systematic reviews. In a systematic review of literature from 15 countries, the prevalence of preventable ED visits ranged from 4.8% to 90% [27], which was a wider range than what we reported. This difference was most likely because we

only included Canadian studies in our systematic review and thus eliminated potential variability in patterns of ED use due to differences in healthcare systems. The systematic review also noted that the large range in prevalence was due to the lack of consensus in the criteria and methods used to identify preventable ED visits [27], which was similarly observed in our study. While most of the studies used CTAS to identify preventable ED visits, studies varied in which levels of CTAS were included or used CTAS in conjunction with other types of criteria. In particular, the lowest estimate (4.3%), reported in the study by Alsabbagh *et al.*, had the most restrictive definition and criteria for identifying preventable ED visits as the authors specifically investigated ED visits for conditions that could be potentially managed by pharmacists within an expanded scope of practice and identified these visits using both CTAS and a subset of FPSCs [37]. Their other estimate (12.4%) was less restrictive as these visits were identified using CTAS and the complete list of FPSCs [37]. The second-lowest estimate (7.2%), reported in the study by Altmayer *et al.*, identified preventable ED visits as those that had listed a SNC as the main reason for the visit [38]. The authors noted, however, that the SNC indicator was designed to be specific rather than sensitive and does not include all conditions that could be treated in primary care settings [38]. In comparison, the highest estimate (59.1%), reported in the study by Khan *et al.*, identified preventable ED visits as less urgent ED visits that were triaged as CTAS ≥ IV [45]. The wide range in the reported estimates of prevalence emphasizes the variations in how preventable ED visits are conceptualized and defined across the literature, and that these estimates can vary depending on the context in which preventable ED visits are explored.

Our findings on the associations between preventable ED visits and the patient-related factors are also consistent with previous research. A systematic review of the US literature found that there was a strong association between preventable ED visits and younger age, low income, poorer health status, and perceived severity of the health condition [21]. In addition, the convenience of EDs compared to primary care settings, poor access to PCPs, and negative perceptions about primary healthcare played a role in patients' decisions to visit the ED [21]. This was also supported in another study which found that patients' perceptions of the accessibility and availability of primary healthcare, as well as the perceived urgency of their symptoms, need for emergency services, being

advised or referred to the ED by HCPs, family, or friends, and the convenience of EDs compared to primary care settings played a key role in their decisions to seek care in EDs [57]. There were, however, several differences in the findings from our study and from a systematic review conducted by Carret *et al* [22]. Our systematic review found that preventable ED visits were associated with worse self-rated health and had conflicting results with sex; Carret *et al.*, however, found that there was no association with self-rated health and that females were more likely to have a preventable ED visit [22]. This difference could have arisen from the small number of studies in our systematic review that reported on self-rated health, as only three studies [36, 40, 45] measured self-rated health and only one study [45] conducted regression analyses to further explore its association with preventable ED visits. As well, only three studies conducted regression analyses for sex; two of the studies had conflicting results [37, 45] while one study [44] found that the association was statistically non-significant. Additional research on the associations between self-rated health, sex, and ED use would provide further insight into how these factors are associated with preventable ED visits.

2.5.1 Limitations

There are several limitations in our systematic review that should be noted. Most of the included studies were cross-sectional studies that used data from patient surveys and questionnaires that were administered in hospital EDs. While the authors of these studies chose EDs that served a large geographic catchment area and were representative of the local population, the results from these studies may not be generalizable to other populations or geographic areas. As well, the findings from these studies could have been affected by potential selection or response bias, which would subsequently affect the results of our systematic review. While the target population of our systematic review was adults and we excluded studies that exclusively investigated paediatric ED utilization, some of the studies in our systematic review did not distinguish children from adults. We were also limited by the methodological quality of the studies, as most studies only reported the descriptive statistics and only four studies conducted regression analyses to further assess the associations between the patient-related factors and preventable ED visits.

Besides these limitations of the individual studies, there are also several limitations at the review-level. Our search strategy incorporated MeSH terms and keywords that had been used in previously published systematic reviews and studies on preventable ED visits. Because of the variations within the literature on how preventable ED visits have been conceptualized and described, we used the keywords “inappropriate”, “non-urgent”, “non-emergent”, “avoidable”, “misuse”, “acuity”, and “unnecessary”, along with Boolean search modifiers to ensure that we captured variations of these keywords. It is possible, however, that our search strategy may not have captured all aspects of preventable ED visits. As well, we were unable to quantitatively synthesize the data due to the heterogeneity in the methods used to identify preventable ED visits and in the reporting of the patient-related factors. Lastly, our risk of bias assessment tool (NOS) was originally developed for case-control and cohort studies, and we used an adapted version of the NOS for cross-sectional studies.

2.5.2 Implications

Despite the above limitations, our study is the first systematic review to synthesize the literature on preventable ED visits in Canada and has several implications for future research. There is a need to develop a more comprehensive measure of preventable ED visits and to develop a standardized definition, criteria and methodology for identifying these visits, which would allow for more precise estimates of prevalence. Future studies that conduct regression analyses would increase the quality of evidence and provide further insight into the associations between various factors and preventable ED visits. There is also a need for more population-based studies, which would increase the generalizability of the evidence. As well, additional research in other provinces or territories besides Ontario would provide more evidence on preventable ED visits in different provinces or territories and across Canada. Lastly, most of the studies in our systematic review explored preventable ED visits in the context of the urgency or acuity of the patient’s ED visit. Because the concept of preventable ED visits also includes a subjective component, future studies that explore patients’ perceptions of their visits and whether they perceived it to be preventable could provide further insight into the driving factors for their decisions to seek care in EDs instead of in primary care settings.

2.5.3 Conclusion

The prevalence of preventable ED visits among adults in Canada ranged from 4.3% to 59.1%. CTAS was most commonly used to identify preventable ED visits, with higher estimates of prevalence associated with studies that identified preventable ED visits as those that were triaged as less urgent or non-urgent. Other types of criteria that were also used included ACSCs, FPSCs, and SNCs. Age, education, income, rurality, and self-rated health were strongly associated with preventable ED visits. Access to primary healthcare, perceptions of urgency and need, and positive perceptions of EDs compared to primary care settings were driving factors for patients choosing to visit the ED. Future population-based research that incorporates these elements will provide further insight into the impact of preventable ED visits in Canada.

2.6 Acknowledgements

We would like to thank the library support staff at the University of Western Ontario Allyn & Betty Taylor Library for their assistance in developing the search strategy for the systematic review.

2.7 Financial Disclosure Statement

The authors received no specific funding for this work.

2.8 Conflicts of Interest

All authors declare that they have no conflicts of interest.

2.9 References

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Chapter 3

3 Preventable Emergency Department Visits in Canada: An Analysis of the 2015-2016 Canadian Community Health Survey

3.1 Abstract

Background: Emergency department (ED) visits for reasons or conditions that could be treated or appropriately managed in primary care settings are considered to be preventable. There is a paucity of population-based Canadian research on preventable ED visits that are characterized by patients' perceptions of their health condition and availability of their regular healthcare provider (HCP) to provide care. **Objective**: To elucidate the key correlates of self-reported preventable ED visits among adults in Canada with a regular HCP. **Methods:** We conducted a secondary analysis of data from the 2015-2016 Canadian Community Health Survey. Respondents were asked if their last ED visit within the past year was preventable (i.e. for a condition that could have been treated by their regular HCP if he/she had been available). Patient characteristics were chosen based on previous research and Andersen's Behavioural Model. Logistic regression analyses were conducted to assess the associations between the patient characteristics and preventable ED visits. **Results:** Our study included 22,529 respondents, of which 39.9% reported having a preventable ED visit in the past year. These visits were significantly associated with younger age, females, low education, being employed, non-white ethnicity, low income, having no recent consultations with a medical doctor, having a strong sense of community belonging, and worse self-rated mental health. **Conclusion:** In Canada, a sizable proportion of ED visits made by adults with a regular HCP were preventable. Additional research on the key correlates identified in our study would assist in developing healthcare policies to improve the delivery of healthcare.

Keywords: Emergency department, primary healthcare, cross-sectional studies, health surveys, population health, Canada

3.2 Introduction

High volumes of emergency department (ED) visits are well documented in the literature. Countries around the world have experienced drastic increases in ED presentations over the past decade [1], contributing to healthcare system problems such as hospital overcrowding and increased wait times [2]. While EDs are intended to provide emergency care to those who have sustained trauma or acute injuries and illnesses, they also provide around-the-clock care for less severe health concerns and represent a safety net for when other healthcare providers (HCPs) are unavailable or inaccessible [3, 4]. With the convenience and ease of access to emergency physicians and comprehensive medical services in a single location without needing a prior appointment [5, 6], EDs are increasingly used as an alternative source of care for non-emergent reasons or conditions, even by those who have a regular HCP that they could receive care from instead [7-9]. These visits, however, are considered to be preventable as these individuals could be treated or appropriately managed in primary care settings [10, 11] and negatively impact the continuity of care between patients and their regular HCP [12]. Furthermore, high rates of preventable ED visits are indicative of underlying health inequalities [13], differential access to primary healthcare [14, 15], and negative patient experiences and dissatisfaction with their regular HCP [16, 17].

Although considerable research has been conducted on exploring the determinants of preventable ED visits [18, 19], the decision to seek care in EDs is complex and multifactorial. Previous studies have found that demographic and socioeconomic status (SES) factors such as age, sex, education, and income are associated with preventable ED visits [11, 20]. Other factors, such as the patient's health status, can influence how they perceive the urgency of their symptoms, need for care, and their decision to visit the ED instead of their regular HCP [5, 10]. Much of the previous research on preventable ED visits, however, have originated from the United States (US) [19] and primarily used objective measures to identify these visits such as a triage system, lists of primary healthcare-treatable diagnoses or conditions, or the types of investigations performed and healthcare resources used during the visit [21, 22]. Canada's healthcare system differs from the US as Canada has a universal, publicly funded healthcare system, in which

Canadians are guaranteed universal healthcare coverage and access to health services without financial or other barriers [23]. While the majority of the Canadian population reports having a regular HCP [24], timely access to primary healthcare is a key public health issue [25, 26]. Barriers in timely access to primary healthcare have been found to play a major role in patients' decisions to visit the ED instead of their regular HCP [27-29]. As well, timeliness is a core component of quality of care [30]; it is important that patients are able to access and receive care from their HCP in a timely manner to prevent further deterioration of their health, potential adverse health outcomes, and to avoid having to visit the ED for reasons or conditions that could have been treated by their regular HCP in the first place [31-33]. To our knowledge, there are no Canadian population-based studies that have identified preventable ED visits using subjective measures that are based on whether patients perceived their visit to be preventable; nor are there Canadian population-based studies that have specifically investigated preventable ED visits made by those who have a regular HCP yet sought care in the ED instead. Investigating preventable ED visits among those who have a regular HCP may provide new insight into the relationship between timely access to primary healthcare and ED utilization.

Therefore, the purpose of this study was to elucidate the key correlates of self-reported preventable ED visits among adults in Canada who have a regular HCP. The study had three specific objectives: (1) to estimate the proportion of ED visits that were self-reported as preventable, (2) to explore the patient characteristics of those who had a preventable ED visit, and (3) to assess the associations between the patient characteristics and preventable ED visits.

3.3 Methods

The following section describes the methodology used in this study. An expanded version of this methods section is provided in Appendix E.

3.3.1 Study Design

This study was a secondary analysis of the 2015-2016 Canadian Community Health Survey (CCHS) public use microdata file (PUMF). Ethical approval was not required for

this study as respondents provided consent for their information to be collected and used by Statistics Canada at the time of their interview. We reported the study methods and results in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [34] (Appendix F).

3.3.2 Data Source

The CCHS is an annual cross-sectional national population health survey that was developed by Statistics Canada, Health Canada, and the Canadian Institute for Health Information (CIHI) [35]. The purpose of the CCHS is to collect information related to health status, healthcare utilization, and health determinants for the Canadian population. This information includes subjects related to chronic diseases and health conditions, overall health, mental health and well-being, health care services, lifestyle, and social conditions. The CCHS collects data from individuals ages 12 or older living in private dwellings in all provinces and territories of Canada. It excludes people living on reserves or other Aboriginal settlements, full-time members of the Canadian Forces, individuals between ages 12 to 17 living in foster homes, the institutionalized population, and those living in the Québec health regions of Région du Nunavik and Région des Terres-Cries-de-la-Baie-James. These exclusions represent approximately 2% of the CCHS's target population. The CCHS uses a multi-stage sample allocation strategy to give relatively fair sample distribution to the health regions and the provinces. Data are collected through computer-assisted personal interviews (CAPI) or computer-assisted telephone interviews (CATI). Proxy reporting from another member of the household is allowed in cases where the selected respondent is unable to complete the interview; however, certain questions that may be more sensitive or personal are skipped. Additional information on the contents of the CCHS, sampling design, and data collection process can be found in Appendix E, where they are described in greater detail.

The 2015-2016 CCHS PUMF includes data collected from January 2015 to December 2016. In total, the PUMF had 109,659 respondents and the response rate was 59.5% [35].

3.3.3 Study Population

For our study, we included respondents ages 18 or older who reported visiting the ED at least once in the past 12 months and had a regular HCP. A regular HCP was defined as a health professional that respondents would regularly see or talk to when they needed care or advice for their health [36]. We excluded respondents who did not visit the ED in the past 12 months and respondents who did not have a regular HCP. We also excluded respondents with missing data on one of the inclusion criteria; i.e., on whether they had visited the ED in the past 12 months or had a regular HCP (responses of "don't know", "refuse", or "not stated"). Furthermore, proxy respondents were not included in our study as some of the variables used in our analyses were not collected from proxy interviews.

3.3.4 Measures

The following section describes how our outcome variable and the patient characteristics included in this study were defined and measured. Additional information on our measures can be found in Appendix E; a list of the CCHS variables included in our analyses can be found in Appendix G.

3.3.4.1 Outcome

The outcome of our study was self-reported preventable ED visits. This was assessed as a binary variable, obtained from the survey question, "The last time you went to the emergency room, was it for a condition that you thought could have been treated by your primary care provider (i.e. regular HCP) if he/she had been available?" Responses of "yes" meant that the respondent perceived their last ED visit to be preventable (i.e. the last time they went to the ED, it was for a condition that they thought could have been treated by their regular HCP if he/she had been available). Responses of "no" meant that the respondent perceived their last ED visit to be non-preventable (i.e. the last time they went to the ED, it was for a condition that they thought could not have been treated by their regular HCP if he/she had been available).

3.3.4.2 Patient Characteristics

The selection of patient characteristics to include in our analyses was guided by previous research and Andersen's Behavioural Model of Health Services Use, which was used to assist in selecting and organizing the patient characteristics. According to Andersen's Behavioural Model, the use of health services is a function of an individual's pre-disposing, enabling, and need characteristics [37]. Pre-disposing characteristics are factors that describe the propensity of individuals to use health services, which includes demographic and social factors [38]. Enabling characteristics describe the resources that individuals have which would allow them to access health services, which includes financial resources, the organization of health services at the individual level, and social support [38]. Need characteristics describe the individual's perceived and evaluated need for care [38]. Andersen's Behavioural Model has undergone numerous changes since its conception, and more recent iterations also include health behaviours that may influence an individual's health status [37, 38].

3.3.4.2.1 Pre-disposing Characteristics

The following pre-disposing characteristics were included in our analyses: age, sex, education level, employment status, marital status, ethnicity, and immigration status.

Age was treated as a categorical variable consisting of three groups: 18-44, 45-64, or ≥ 65 years. Sex was reported as a binary variable of male or female. The highest education level attained by the respondent was treated as a binary variable of less than secondary school or secondary school and beyond. Employment status was treated as a binary variable of employed (part-time or full-time) or unemployed. Marital status was treated as a binary variable of married/common-law or widowed/divorced/separated/single. Ethnicity was treated as a binary variable of white or non-white. Immigration status was treated as a categorical variable consisting of three groups: Canadian-born, non-permanent resident (NPR) or recent (0-9 years) landed immigrant, or established (≥ 10 years) landed immigrant.

3.3.4.2.2 Enabling Characteristics

The following enabling characteristics were included in our analyses: total household income, insurance for prescription medications, consultations with a medical doctor, and sense of community belonging.

The respondent's total household income was treated as a categorical variable of three groups: ≤ $39,999, $40,000-$79,999, or ≥ $80,000. Having insurance for prescription medications was reported as a binary variable of yes or no. Consultations with a medical doctor (including family physicians, general practitioners, or specialists such as a surgeon, allergist, orthopaedist, urologist, gynaecologist, or psychiatrist) in the past 12 months were treated as a binary variable of no consultations or ≥ 1 consultation. Sense of community belonging was treated as a binary variable of strong or weak.

3.3.4.2.3 Need Characteristics

The following need characteristics were included in our analyses: multimorbidity, self-rated general health, and self-rated mental health.

Multimorbidity was treated as a binary variable (yes or no) and defined as the respondent having two or more chronic conditions from a list developed by a Public Health Agency of Canada (PHAC) working group [39, 40]. These chronic conditions included: asthma, chronic obstructive pulmonary disease, arthritis, heart disease, stroke, diabetes, cancer, and mental disorder (defined as either a mood disorder or an anxiety disorder). Of note, the PHAC working group included Alzheimer's disease; however, this variable was not available in the PUMF and excluded from our list of chronic conditions. Self-rated general health and self-rated mental health were both reported as categorical variables consisting of the following groups: poor, fair, good, very good, or excellent.

3.3.4.2.4 Health Behaviours

The following health behaviours were included in our analyses: binge-drinking, smoking status, and illicit drug use.

Binge-drinking was treated as a binary variable (yes or no) and defined as having 5 (if male) or 4 (if female) or more alcoholic drinks on one occasion within the past 12 months [36, 41]. Smoking status was determined based on the respondent's current and past smoking habits and treated as a binary variable of yes (current smoker) or no (current non-smoker or lifetime abstainer). Illicit drug use in the past 12 months was reported as a binary variable of yes or no.

3.3.4.2.5 Survey Design Variables

In addition to the above patient characteristics, two survey design variables were included in the analyses to account for differences in how the survey was conducted. The mode of the interview was reported as a binary variable of CAPI or CATI. Respondents being alone during the interview was reported as a binary variable of yes or no.

3.3.5 Missing Data

Missing data arose from non-responses to the survey questions ("don't know", "refuse", or "not stated"). In our sample, 11.5% of respondents had missing information on at least one of the variables in our analyses and the outcome variable had the highest amount of missing data (2.9%). Based on a visual assessment of the missing data pattern and after examining the relationships between the non-responses and the outcome variable, we concluded that the missing data pattern was arbitrary and missing at random (MAR) since the likelihood of the data being missing completely at random (MCAR) is very unlikely in large epidemiological studies and there is no definitive method for determining if the data are missing not a random (MNAR) [42].

To account for the missing data in our study, we conducted multiple imputation by fully conditional specification (MI-FCS). MI-FCS is an effective statistical technique for handling missing data that are MAR and of an arbitrary pattern [43]. Furthermore, one of the advantages of MI-FCS is its flexibility as it uses separate, conditional distributions for each type of variable (continuous, ordinal categorical, nominal categorical, or binary) [43]. Additional information on the MI-FCS procedure can be found in Appendix E.

3.3.6 Statistical Analysis

We first obtained the unweighted univariate statistics to describe the patient characteristics of our study sample and then, to meet our first objective, we applied sampling weights to estimate the proportion of ED visits that were self-reported to be preventable. The sampling weights were provided by the CCHS and re-scaled to our sample so that our estimates and results would be representative of the population (see Appendix E for more information on the sampling weights). For our second objective, we obtained the weighted bivariate descriptive statistics to describe the patient characteristics of those who reported having a preventable or non-preventable ED visit. For our third objective, we conducted a series of univariable and multivariable logistic regression analyses using the imputed data. Univariable logistic regression analyses (unadjusted models) were conducted to assess the unadjusted association between each patient characteristic and preventable ED visits and we only controlled for the survey design variables. Next, a multivariable logistic regression analysis (adjusted model) was conducted to assess the associations between the patient characteristics and the outcome variable while adjusting for the effects of the other patient characteristics in the model and the survey design variables. Lastly, a sensitivity analysis for the unadjusted and adjusted models was conducted by using the non-imputed data and complete case analysis (CCA), in which respondents who had missing responses on at least one variable were excluded from the analysis. Additional information on the statistical analysis can be found in Appendix E.

For the univariate and bivariate descriptive statistics, the frequencies and percentages were reported. For the logistic regression analyses, the unadjusted odds ratios (UOR) were reported for the univariable logistic regression analyses and the adjusted odds ratios (AOR) were reported for the multivariable logistic regression analysis, as well as the 95% confidence intervals (CI) and p-values.

All statistical analyses were conducted using SAS 9.4 (SAS Institute Inc., Cary, NC, USA). We assessed for multicollinearity among the variables by calculating the variance inflation factor (VIF) and tolerance (Appendix E). None of the variables had a VIF ≥ 5

and a tolerance ≤ 0.2 (Appendix H) [44], suggesting an absence of multicollinearity. Statistical significance was determined at the level of $p < 0.05$.

3.4 Results

The PUMF of the 2015-2016 CCHS included 109,659 respondents. After removing respondents ages 17 or younger and proxy interviews, the sample included 98,299 respondents. After removing respondents who did not visit the ED in the past 12 months or had missing responses, the sample included 26,432 respondents. Lastly, after removing respondents who did not have a regular HCP or had missing responses, 22,529 respondents remained in the sample and were included in our analyses (Figure 3.1).

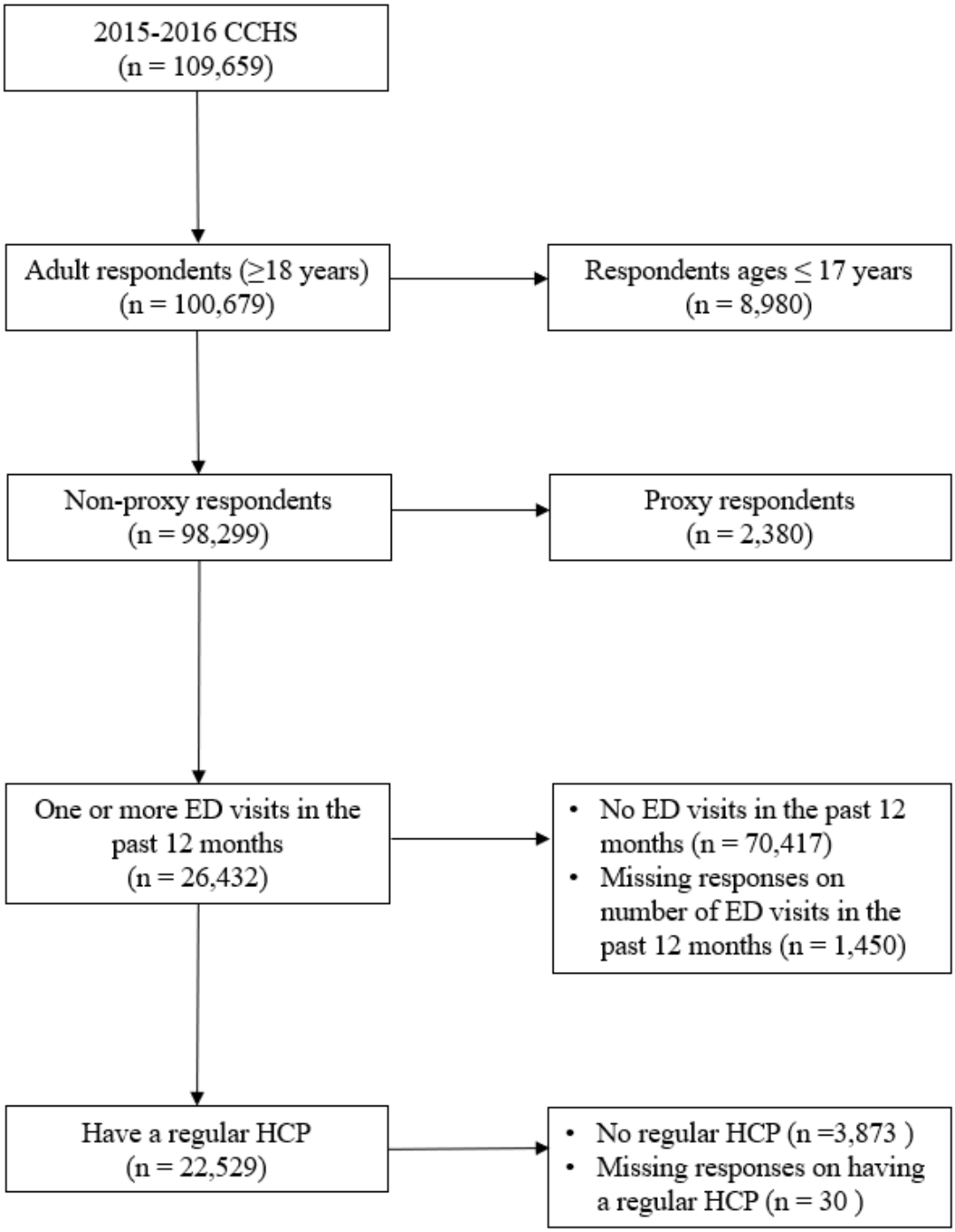

Figure 3.1: Flowchart of study sample inclusion/exclusion

CCHS: Canadian Community Health Survey; ED: emergency department; HCP: healthcare provider

3.4.1 Sample Characteristics

Table 3.1 presents the unweighted patient characteristics of the respondents in our sample. For the pre-disposing characteristics, most respondents were between ages 18 to 44 (36.3%), were female (58.4%), had an education level of secondary school and beyond (81.4%), were employed (50.5%), were married or common-law (53.2%), were of white ethnicity (84.8%), and were born in Canada (85.8%). For the enabling characteristics, a large proportion of respondents reported having a total household income of $80,000 or more (36.0%), and the majority had insurance for prescription medications (80.2%), had at least one consultation with a medical doctor in the past 12 months (86.0%), and had a strong sense of community belonging (68.1%). For the need characteristics, most respondents were not multimorbid (72.4%), rated their general health as good (31.6%), and rated their mental health as very good (34.6%). Lastly, for health behaviours, the majority of respondents reported that they did not binge-drink in the past 12 months (58.6%), did not smoke (78.0%), and did not use illicit drugs in the past 12 months (88.9%).

Table 3.1: Patient characteristics of CCHS sample (n = 22,529)

	Frequency (N)	Percentage (%)
Pre-disposing Characteristics		
Age		
18-44	8,170	36.3
45-64	7,528	33.4
≥ 65	6,831	30.3
Sex		
Female	13,166	58.4
Male	9,363	41.6
Education level		
Less than secondary school	3,923	17.4
Secondary school and beyond	18,340	81.4
Missing	266	1.2
Employment status		
Unemployed	10,821	48.0
Employed	11,372	50.5
Missing	336	1.5
Marital status		
Widowed/divorced/ separated/single	10,478	46.5
Married/common-law	11,982	53.2
Missing	69	0.3
Ethnicity		
White	19,106	84.8
Non-white	2,999	13.3
Missing	424	1.9
Immigration status		
Canadian-born	19,327	85.8
NPR or recent landed immigrant	646	2.9
Established landed immigrant	2,031	9.0
Missing	525	2.3
Enabling Characteristics		
Total household income		
≤ $39,999	7,486	33.2
$40,000-$79,999	6,888	30.6
≥ $80,000	8,120	36.0
Missing	35	0.2
Insurance for prescription medications		
No	4,074	18.1
Yes	18,071	80.2

Missing	384	1.7
Consultations with a medical doctor		
No consultations	2,829	12.6
≥ 1 consultation	19,385	86.0
Missing	315	1.4
Sense of community belonging		
Weak	6,857	30.4
Strong	15,347	68.1
Missing	325	1.4
Need Characteristics		
Multimorbidity		
No	16,317	72.4
Yes	6,210	27.6
Missing	2	0.01
Self-rated general health		
Poor	1,541	6.8
Fair	3,479	15.4
Good	7,110	31.6
Very good	7,043	31.3
Excellent	3,297	14.6
Missing	59	0.3
Self-rated mental health		
Poor	582	2.6
Fair	1,824	8.1
Good	5,974	26.5
Very good	7,791	34.6
Excellent	6,300	28.0
Missing	58	0.3
Health Behaviours		
Binge-drinking		
No	13,209	58.6
Yes	9,199	40.8
Missing	121	0.5
Smoking status		
No	17,566	78.0
Yes	4,897	21.7
Missing	66	0.3
Illicit drug use		
No	20,034	88.9
Yes	2,419	10.7
Missing	76	0.3

CCHS: Canadian Community Health Survey; ED: emergency department; NPR: non-permanent resident

3.4.2 Objective 1 – Proportion of Preventable ED Visits

After applying the sampling weights, 39.9% (95% CI 39.3%-40.6%) of adults in 2015-2016 who had at least one ED visit in the past 12 months and had a regular HCP considered their last ED visit to be preventable.

3.4.3 Objective 2 – Patient Characteristics by Preventable ED Visits

Table 3.2 presents the patient characteristics for those who reported having a preventable or non-preventable ED visit. A greater proportion of patients who had a preventable ED visit were younger (43.9% ages 18-44 vs. 39.2% ages 45-64 vs. 32.2% ages ≥ 65 years), were female (40.9% vs. 38.8% male), had an education level of less than secondary school (40.6% vs. 39.8% secondary school and beyond), were employed (42.6% vs. 36.0% unemployed), were widowed/divorced/separated/single (41.3% vs. 39.1% married/common-law), were of non-white ethnicity (41.5% vs. 39.7% of white ethnicity), and were NPR or recent landed immigrants (41.5% vs. 41.0% Canadian-born vs. 33.7% established landed immigrants). In addition, most patients who had a preventable ED visit had a total household income between $40,000 to $79,999 (42.7% vs. 38.8% with a total household income ≥ $80,000 vs. 38.7% with a total household income ≤ $39,999), did not have insurance for prescription medications (41.7% vs. 39.6% had insurance), had no consultations with a medical doctor in the past 12 months (46.4% vs. 39.0% had ≥ 1 consultation), and had a strong sense of community belonging (40.9% vs. 38.3% had a weak sense of community belonging). Furthermore, a higher proportion of patients who had a preventable ED visit were not multimorbid (41.4% vs. 34.6% multimorbid), and had better perceptions of their general health (43.6% rated as excellent vs. 42.7% rated as very good vs. 38.6% rated as good vs. 36.4% rated as fair vs. 29.2% rated as poor). Patients were almost equally distributed in how they rated their mental health (ranging between 38% to 41% for all categories). For health behaviours, most patients who had a preventable ED visit reported binge-drinking in the past 12 months (41.8% vs. 38.4% did not binge-drink), were current smokers (40.8% vs. 39.7% did not smoke), and 40.0% reported using illicit drugs while 40.0% reported not using illicit drugs in the past 12 months.

Table 3.2: Weighted patient characteristics by preventable or non-preventable ED visits

	Non-preventable ED visit (n = 13,118)		Preventable ED visit (n = 8,720)	
	Frequency (N)	Percentage (%)	Frequency (N)	Percentage (%)
Pre-disposing characteristics				
Age				
18-44	5,658	56.1	4,422	43.9
45-64	4,478	60.9	2,880	39.2
≥ 65	2,982	67.8	1,418	32.2
Sex				
Female	7,145	59.1	4,939	40.9
Male	5,972	61.2	3,781	38.8
Education level				
Less than secondary school	1,723	59.4	1,176	40.6
Secondary school and beyond	11,212	60.2	7,426	39.8
Employment status				
Unemployed	5,422	64.0	3,046	36.0
Employed	7,447	57.4	5,519	42.6
Marital status				
Widowed/divorced/ separated/single	4,993	58.7	3,511	41.3
Married/common-law	8,082	60.9	5,191	39.1
Ethnicity				
White	10,194	60.3	6,709	39.7
Non-white	2,604	58.5	1,848	41.5
Immigration status				
Canadian-born	10,091	59.0	7,019	41.0
NPR or recent landed immigrant	693	58.5	492	41.5
Established landed immigrant	1,984	66.3	1,007	33.7
Enabling characteristics				
Total household income				
≤ $39,999	3,317	61.3	2,094	38.7
$40,000-$79,999	3,726	57.4	2,771	42.7
≥ $80,000	6,067	61.2	3,845	38.8
Insurance for prescription medications				
No	2,255	58.3	1,613	41.7
Yes	10,574	60.4	6,922	39.6
Consultations with a medical doctor				
No consultations	1,556	53.6	1,349	46.4
≥ 1 consultation	11,394	61.0	7,291	39.0
Sense of community belonging				

Weak	4,368	61.7	2,716	38.3
Strong	8,558	59.1	5,914	40.9
Need characteristics				
Multimorbidity				
No	9,980	58.6	7,057	41.4
Yes	3,138	65.4	1,662	34.6
Self-rated general health				
Poor	898	70.8	370	29.2
Fair	1,900	63.6	1,087	36.4
Good	4,055	61.4	2,551	38.6
Very good	4,134	57.3	3,082	42.7
Excellent	2,097	56.4	1,622	43.6
Self-rated mental health				
Poor	333	61.5	209	38.5
Fair	1,022	60.0	681	40.0
Good	3,329	60.5	2,175	39.5
Very good	4,509	59.4	3,083	40.6
Excellent	3,881	60.3	2,555	39.7
Health behaviours				
Binge-drinking				
No	7,295	61.6	4,550	38.4
Yes	5,746	58.2	4,121	41.8
Smoking status				
No	10,345	60.3	6,822	39.7
Yes	2,735	59.2	1,887	40.8
Illicit drug use				
No	11,415	60.0	7,603	40.0
Yes	1,644	60.1	1,094	40.0

ED: emergency department; NPR: non-permanent resident

3.4.4 Objective 3 – Association Between Patient Characteristics and Preventable ED Visits

Table 3.3 presents the UOR of the univariable logistic regression analyses (unadjusted models) and the AOR of the multivariable logistic regression analysis (adjusted model), with the corresponding 95% CI and p-values.

For the pre-disposing characteristics, age, sex, employment status, ethnicity, and immigration status were statistically significant in both models. Those who were younger had significantly higher odds of having a preventable ED visit than the oldest age group, with the youngest age group having the highest odds (AOR for ages 18-44 = 1.423, 95% CI 1.287-1.573; AOR for ages 45-64 = 1.294, 95% CI 1.178-1.421). Females had significantly higher odds of having a preventable ED visit than males (AOR = 1.099, 95% CI 1.034-1.168). Compared to those who were unemployed, those who were employed had significantly higher odds of having a preventable ED visit (AOR for employed = 1.160, 95% CI 1.077-1.251). As well, those of non-white ethnicity had significantly higher odds of having a preventable ED visit than those who were of white ethnicity (AOR = 1.129, 95% CI 1.037-1.228). Compared to those who were born in Canada, those who were not born in Canada were less likely to have a preventable ED visit, with established landed immigrants having the lowest odds (AOR for established landed immigrant = 0.750, 95% CI 0.666-0.843; AOR for NPR or recent landed immigrant = 0.831, 95% CI 0.726-0.951). Furthermore, there were differences in statistical significance between the unadjusted and adjusted estimates for education level and marital status. In the unadjusted model, those who were widowed/divorced/separated/single had significantly higher odds of having a preventable ED visit than those who were married/common-law; however, this association became non-significant after adjusting for the other variables (AOR = 1.036, 95% CI 0.971-1.105). Education level was not a significant correlate in the unadjusted model; however, it became significant in the adjusted model with those who had a lower education level having significantly higher odds of having a preventable ED visit than those who had an education level of secondary school and beyond (AOR = 1.195, 95% CI 1.078-1.324).

For the enabling characteristics, the results from the unadjusted and adjusted models were similar except for insurance for prescription medications. Lower total household income was significantly associated with preventable ED visits, with those who reported a total household income between $40,000-$79,999 having the highest odds of having a preventable ED visit compared to the highest income category (AOR for total household income between $40,000 to $79,999 = 1.270, 95% CI 1.186-1.361; AOR for total household income of $39,999 or less = 1.169, 95% CI 1.075-1.272). As well, those who had no consultations with a medical doctor in the past 12 months had significantly higher odds of having a preventable ED visit than those who had at least one consultation (AOR = 1.226, 95% CI 1.127-1.333). Furthermore, having a strong sense of community belonging was associated with a higher likelihood of having a preventable ED visit than having a weak sense of community belonging (AOR = 1.119, 95% CI 1.051-1.192). Insurance for prescription medications – which was a significant correlate in the unadjusted model – became non-significant after adjusting for the other variables (AOR = 1.050, 95% CI 0.970-1.136).

The associations between the need characteristics and preventable ED visits were consistent in the unadjusted and adjusted models except for self-rated mental health. In both models, those who were multimorbid were less likely to have a preventable ED visit than those who were not multimorbid (AOR = 0.901, 95% CI 0.829-0.978). As well, those who had worse perceptions of their general health were less likely to have a preventable ED visit than those who rated their general health as excellent (AOR for poor self-rated general health = 0.570, 95% CI 0.484-0.671; AOR for fair self-rated general health = 0.760, 95% CI 0.678-0.852; AOR for good self-rated general health = 0.820, 95% CI 0.749-0.898). There were, however, changes in significance for self-rated mental health. In the adjusted model, those who had worse perceptions of their mental health were more likely to have a preventable ED visit than those who rated their mental health as excellent (AOR for poor self-rated mental health = 1.409, 95% CI 1.152-1.724; AOR for fair self-rated mental health = 1.252, 95% CI 1.089-1.439; AOR for good self-rated mental health = 1.134, 95% CI 1.041-1.236). These results differed from the unadjusted model, where self-rated mental health was not a significant correlate.

For the health behaviours, both models found that smoking status was not a significant correlate of preventable ED visits. Binge-drinking was initially associated with a significantly higher likelihood of having a preventable ED visit in the unadjusted model but became non-significant after adjusting for the other variables (AOR = 0.987, 95% CI 0.921-1.059). Illicit drug use was the only health behaviour that was significant in the adjusted model, although initially this relationship was non-significant. Specifically, after adjusting for the other variables, those who used illicit drugs were significantly less likely to have a preventable ED visit than those who did not use illicit drugs (AOR = 0.879, 95% CI 0.800-0.966).

Table 3.3: Associations between patient characteristics and having a preventable ED visit

	Univariable logistic regression (Unadjusted models)[a]				Multivariable logistic regression (Adjusted model)[b]			
	UOR	95% LCL	95% UCL	p-value	AOR	95% LCL	95% UCL	p-value
Pre-disposing Characteristics								
Age								
18-44	1.637	1.516	1.767	<.0001	1.423	1.287	1.573	<.0001
45-64	1.354	1.249	1.467	<.0001	1.294	1.178	1.421	<.0001
≥ 65	1.000				1.000			
Sex								
Female	1.093	1.030	1.159	0.0032	1.099	1.034	1.168	0.0026
Male	1.000				1.000			
Education level								
Less than secondary school	1.030	0.940	1.129	0.5211	1.195	1.078	1.324	0.0008
Secondary school and beyond	1.000				1.000			
Employment status								
Unemployed	1.000				1.000			
Employed	1.321	1.246	1.401	<.0001	1.160	1.077	1.251	0.0001
Marital status								
Widowed/divorced/ separated/single	1.088	1.026	1.155	0.0052	1.036	0.971	1.105	0.2836
Married/common-law	1.000				1.000			
Ethnicity								
White	1.000				1.000			
Non-white	1.076	1.002	1.154	0.0431	1.129	1.037	1.228	0.0050
Immigration status								
Canadian-born	1.000				1.000			
NPR or recent landed immigrant	1.013	0.896	1.145	0.8350	0.831	0.726	0.951	0.0070
Established landed immigrant	0.746	0.675	0.824	<.0001	0.750	0.666	0.843	<.0001
Enabling Characteristics								
Total household income								
≤ $39,999	0.984	0.918	1.056	0.6600	1.169	1.075	1.272	0.0003
$40,000-$79,999	1.165	1.089	1.245	<.0001	1.270	1.186	1.361	<.0001
≥ $80,000	1.000				1.000			
Insurance for prescription medications								
No	1.085	1.005	1.172	0.0364	1.050	0.970	1.136	0.2256
Yes	1.000				1.000			

Consultations with a medical doctor								
No consultations	1.344	1.240	1.457	<.0001	1.226	1.127	1.333	<.0001
≥ 1 consultation	1.000				1.000			
Sense of community belonging								
Weak	1.000				1.000			
Strong	1.110	1.043	1.181	0.0010	1.119	1.051	1.192	0.0005
Need Characteristics								
Multimorbidity								
No	1.000				1.000			
Yes	0.749	0.698	0.804	<.0001	0.901	0.829	0.978	0.0128
Self-rated general health								
Poor	0.528	0.460	0.606	<.0001	0.570	0.484	0.671	<.0001
Fair	0.736	0.666	0.814	<.0001	0.760	0.678	0.852	<.0001
Good	0.814	0.747	0.886	<.0001	0.820	0.749	0.898	<.0001
Very good	0.969	0.892	1.051	0.4447	0.970	0.892	1.055	0.4829
Excellent	1.000				1.000			
Self-rated mental health								
Poor	0.934	0.778	1.120	0.4584	1.409	1.152	1.724	0.0009
Fair	1.012	0.892	1.149	0.8521	1.252	1.089	1.439	0.0017
Good	0.994	0.919	1.075	0.8787	1.134	1.041	1.236	0.0040
Very good	1.045	0.974	1.121	0.2234	1.072	0.997	1.154	0.0615
Excellent	1.000				1.000			
Health Behaviours								
Binge-drinking								
No	1.000				1.000			
Yes	1.150	1.086	1.219	<.0001	0.987	0.921	1.059	0.7194
Smoking status								
No	1.000				1.000			
Yes	1.044	0.972	1.120	0.2373	0.994	0.920	1.075	0.8886
Illicit drug use								
No	1.000				1.000			
Yes	0.991	0.911	1.079	0.8398	0.879	0.800	0.966	0.0077

AOR: adjusted odds ratio; ED: emergency department; LCL: lower confidence limit; NPR: non-permanent resident; UCL: upper confidence limit; UOR: unadjusted odds ratio

[a] Unadjusted models included the outcome variable, individual patient characteristic, and the survey design variables.

[b] Adjusted model included the outcome variable, all pre-disposing characteristics, enabling characteristics, need characteristics, health behaviours, and the survey design variables.

3.4.5 Sensitivity Analysis

Table 3.4 presents the results from the sensitivity analysis of the unadjusted and adjusted models, which were conducted using CCA. The estimates obtained from MI-FCS and the estimates obtained from CCA were similar in effect size, direction, and level of significance, indicating that our results were robust to missing data.

Table 3.4: Sensitivity analysis of associations between patient characteristics and having a preventable ED visit, using CCA

	Univariable logistic regression (Unadjusted models)[a]				Multivariable logistic regression (Adjusted model)[b]			
	UOR	95% LCL	95% UCL	p-value	AOR	95% LCL	95% UCL	p-value
Pre-disposing Characteristics								
Age								
18-44	1.653	1.533	1.783	<.0001	1.472	1.327	1.633	<.0001
45-64	1.337	1.235	1.448	<.0001	1.309	1.188	1.443	<.0001
≥ 65	1.000				1.000			
Sex								
Female	1.084	1.026	1.145	0.0041	1.089	1.026	1.156	0.0050
Male	1.000				1.000			
Education level								
Less than secondary school	1.043	0.962	1.131	0.3033	1.200	1.096	1.313	<.0001
Secondary school and beyond	1.000				1.000			
Employment status								
Unemployed	1.000				1.000			
Employed	1.320	1.247	1.397	<.0001	1.182	1.098	1.273	<.0001
Marital status								
Widowed/divorced/ separated/single	1.090	1.030	1.153	0.0027	1.021	0.958	1.088	0.5256
Married/common-law	1.000				1.000			
Ethnicity								
White	1.000				1.000			
Non-white	1.079	1.009	1.155	0.0267	1.093	1.005	1.190	0.0388
Immigration status								
Canadian-born	1.000				1.000			
NPR or recent landed immigrant	1.036	0.919	1.168	0.5625	0.835	0.727	0.959	0.0107
Established landed immigrant	0.734	0.677	0.797	<.0001	0.758	0.687	0.837	<.0001
Enabling Characteristics								
Total household income								
≤ $39,999	0.995	0.928	1.067	0.8894	1.206	1.106	1.315	<.0001
$40,000-$79,999	0.169	1.096	1.247	<.0001	1.321	1.232	1.417	<.0001
≥ $80,000	1.000				1.000			
Insurance for prescription medications								
No	1.090	1.015	1.170	0.0181	1.051	0.973	1.134	0.2077
Yes	1.000				1.000			

Consultations with a medical doctor								
No consultations	1.353	1.250	1.465	<.0001	1.197	1.099	1.304	<.0001
≥ 1 consultation	1.000				1.000			
Sense of community belonging								
Weak	1.000				1.000			
Strong	1.110	1.046	1.177	0.0005	1.131	1.061	1.204	0.0001
Need Characteristics								
Multimorbidity								
No	1.000				1.000			
Yes	0.748	0.699	0.800	<.0001	0.877	0.809	0.951	0.0015
Self-rated general health								
Poor	0.529	0.460	0.609	<.0001	0.590	0.497	0.701	<.0001
Fair	0.741	0.671	0.819	<.0001	0.780	0.692	0.879	<.0001
Good	0.810	0.746	0.880	<.0001	0.823	0.749	0.903	<.0001
Very good	0.960	0.885	1.040	0.3170	0.942	0.864	1.027	0.1733
Excellent	1.000				1.000			
Self-rated mental health								
Poor	0.958	0.798	1.151	0.6460	1.433	1.159	1.771	0.0009
Fair	1.001	0.896	1.117	0.9893	1.210	1.065	1.375	0.0034
Good	0.998	0.926	1.075	0.9514	1.118	1.027	1.217	0.0098
Very good	1.034	0.966	1.107	0.3349	1.065	0.989	1.147	0.0935
Excellent	1.000				1.000			
Health Behaviours								
Binge-drinking								
No	1.000				1.000			
Yes	1.147	1.086	1.212	<.0001	0.983	0.920	1.049	0.6002
Smoking status								
No	1.000				1.000			
Yes	1.052	0.983	1.125	0.1412	0.978	0.907	1.055	0.5675
Illicit drug use								
No	1.000				1.000			
Yes	0.998	0.919	1.085	0.0014	0.884	0.805	0.971	0.0102

AOR: adjusted odds ratio; ED: emergency department; LCL: lower confidence limit; NPR: non-permanent resident; UCL: upper confidence limit; UOR: unadjusted odds ratio

[a] Unadjusted models included the outcome variable, individual patient characteristic, and the survey design variables.

[b] Adjusted model included the outcome variable, all pre-disposing characteristics, enabling characteristics, need characteristics, health behaviours, and the survey design variables.

3.5 Discussion

We conducted a secondary analysis of data from the 2015-2016 CCHS to elucidate the key correlates of preventable ED visits among adults in Canada with a regular HCP. Based on the estimates from our weighted, nationally representative sample, 39.9% of adults who had at least one ED visit in the past 12 months and had a regular HCP considered their last ED visit to be preventable. Using evidence from previous research and Andersen's Behavioural Model to assist in selecting and organizing our variables, we investigated the associations between the following patient characteristics and preventable ED visits: pre-disposing characteristics (age, sex, education level, employment status, marital status, ethnicity, and immigration status), enabling characteristics (total household income, insurance for prescription medications, consultations with a medical doctor, and sense of community belonging), need characteristics (multimorbidity, self-rated general health, and self-rated mental health), and health behaviours (binge-drinking, smoking status, and illicit drug use). In the univariable logistic regression analyses (unadjusted models), all patient characteristics were statistically significant except for education level, self-rated mental health, smoking status, and illicit drug use. In the multivariable logistic regression analysis (adjusted model), education level, self-rated mental health, and illicit drug use became significant while marital status, insurance for prescription medications, and binge-drinking became non-significant. Smoking status remained non-significant in both models. Based on the results from the multivariable logistic regression analysis, preventable ED visits were significantly associated with younger age, females, low education level, being employed, non-white ethnicity, low total household income, having no consultations with a medical doctor in the past 12 months, having a strong sense of community belonging, and worse self-rated mental health. Those who were not born in Canada (NPR or landed immigrants), were multimorbid, had worse self-rated general health, and used illicit drugs were significantly less likely to have a preventable ED visit. Lastly, our sensitivity analysis of both models by CCA indicated that our results were robust to missing data.

In both models, those who were younger, were female, were employed, or were of non-white ethnicity had higher odds of having a preventable ED visit. Our findings on age are

consistent with the literature, as previous studies have found that older adults use ED services at higher rates and their visits are more likely to be of higher urgency and acuity [45, 46]; thus, they may be less willing to delay seeking care until their regular HCP become available and less likely to view their ED visits as preventable. Multiple studies have also found sex differences in health services use; while females are more likely than males to report having a regular HCP [47], they are also more likely to report difficulties in accessing health services for routine or immediate care [48]. These difficulties in accessing health services – especially for immediate care – coupled with feelings of urgency and need for care could subsequently result in visits to the ED when their regular HCP is unavailable. As well, we found that those who were employed had a higher likelihood of having a preventable ED visit than those who were unemployed. This may reflect resource constraints in terms of time, as previous studies have found that factors such as long wait times in a physician's office, limited availability of primary healthcare outside of business hours, and EDs as one of the few alternatives that are able to accommodate work schedules contributed to patients' decisions to seek care in EDs instead of from their regular HCP [10, 29]. Our findings of non-white ethnicities having higher odds of having a preventable ED visit are similar to studies that have found ethnic disparities in access to and use of primary health services [49, 50].

For immigration status, we found that those who were not born in Canada were less likely to have a preventable ED visit than those born in Canada, with established landed immigrants having the lowest odds. Previous studies have found that immigrants are more likely to report difficulties in accessing health services [47, 48]. If, however, difficulties in accessing primary healthcare is a driving factor for preventable ED visits then immigrants should have higher odds of having a preventable ED visit, which was not observed in our study. A potential explanation for this could be cultural differences in perceptions of health and use of health services, or differences between Canadian-born and foreign-born populations in their health status and unmet healthcare needs. Previous studies have found that immigrants report better health than the native population [51] and are less likely to report unmet healthcare needs [47]; thus, immigrants may limit their use of EDs for reasons or conditions that they perceive to be serious enough to require emergency care and to be non-preventable. Further research that investigates the

association between preventable ED visits and immigration status and which also considers factors such as differences between immigrant groups in ethnicity or culture are needed to better understand the health inequalities and disparities that are experienced by these sub-populations.

Interestingly, we observed changes in statistical significance between the unadjusted and adjusted models for education level and marital status. Education level was not significantly associated with preventable ED visits in the unadjusted model but became a significant correlate in the adjusted model. VanStone *et al.* previously found that those of low SES (measured using social and material elements including living arrangements, marital status, family structure, education level, income, and employment) had higher rates of ED visits than those in higher SES groups, and especially for ED visits that of low acuity [52]. In another study, Khan *et al.* found that education level was independently associated with higher odds of having a less urgent ED visit [53]. The association between low education level and preventable ED visits may reflect lower health literacy or limited knowledge of health services and self-management of health conditions, which have been found to be associated with preventable ED visits [54]. On the other hand, the association between preventable ED visits and marital status became non-significant in the adjusted model. A potential explanation for this change in significance may be because our adjusted model controlled for potential confounding by age or sense of community belonging. Having a strong sense of community belonging was a significant correlate of preventable ED visits in both models, which is consistent with research that has found that social support and social connectedness influences the use of health services [55, 56] and that the views and advice from family and friends especially play a role in patients' decisions to seek care in EDs [5]. The differences in these associations suggests that community social support and social connectedness (generated from a strong sense of community belonging) may exert different effects on health services and ED use than support from a significant other or spouse, and that they may have different effects in how patients assess their ED visits and perceive if it was preventable or not.

Our findings on the associations between the enabling characteristics and preventable ED visits are also consistent with the literature. Previous studies have identified low income as a determinant of limited access to primary healthcare [49, 57] and associated with increases in both overall and preventable ED visits [52, 53]. In our study, consultations with a medical doctor were included in our analyses to represent the use of health services. We found that those who had no consultations with a medical doctor in the past 12 months were more likely to have a preventable ED visit than those who had at least one visit, which is consistent with research that has found that better actual access to medical doctors is associated with a decrease in overall and non-emergent ED visits [58, 59]. The magnitude and strength of this association, however, may differ based on the frequency of these consultations as this may indicate a greater continuity of care or stronger healthcare-seeking behaviours. This would also affect patients' perceptions of their health, their use of health services, and decisions to visit the ED as an alternative source of care when their regular HCP is unavailable or unable to provide care. As well, we were unable to determine if the lack of consultations with a medical doctor was directly related to the preventable ED visit due to the cross-sectional nature of our study. Insurance for prescription medications was not a significant correlate in our adjusted model, suggesting that its initially significant association in the unadjusted model had been confounded by other variables. In Canada, prescription medications are covered by a mixture of private and publicly-funded insurance plans, and the amount of coverage is based on factors such as the type of medication, age, employment, household income, and province or territory of residence [60]. Our findings indicate that insurance for prescription medications is not independently associated with preventable ED visits in the context of patients' perceptions of their visits and of the availability and ability of their regular HCP to provide care for their health condition.

Of the health behaviours included in our analyses, only illicit drug use was statistically significant in the adjusted model. This association was non-significant in the unadjusted model, but after adjusting for other patient characteristics it was found that those who used illicit drugs in the past 12 months were less likely to have a preventable ED visit than those who did not use illicit drugs. Previous studies have found that illicit drug use is associated with poorer self-rated health [61], increased risk of adverse health outcomes

[62], and increased rates of ED visits [63]. Due to the nature of the survey question and cross-sectional design of the CCHS, however, we were unable to determine the frequency and extent to which illicit drugs were used (such as one-time use or illicit drug dependence) or if the preventable ED visit was directly related to the illicit drug use.

In our study, we found that worse self-rated general health and multimorbidity were associated with a lower likelihood of having a preventable ED visit. Previous studies have found that multimorbidity is associated with worse self-rated health [64]; thus, those who have co-morbidities and poorer perceptions of their health may view their health condition and illness to be more complex, urgent, and subsequently turn to EDs when their regular HCP is unavailable. Our findings on self-rated mental health, however, were opposite to our results on self-rated general health and multimorbidity. In the unadjusted model, self-rated mental health was not significantly associated with preventable ED visits. In the adjusted model, however, worse self-rated mental health became significantly associated with having a preventable ED visit. Previous studies have found that self-rated general health and self-rated mental health are associated with each other [65]; thus, they may have been confounders to each other in the unadjusted model. As well, a potential explanation for the association between worse self-rated mental health and preventable ED visits may be because our study identified preventable ED visits retrospectively and based on respondents' recall of their last ED visit; thus, respondents would have had a period of time since their last visit to reflect upon the nature of their visit and re-evaluate whether it could have been treated by their regular HCP or not. Their retrospective perceptions of their health condition and last ED visit may be more strongly affected by their mental health. Additional research that investigates the dimensions of health covered by self-rated mental health and self-rated general health would provide further insight into their associations with preventable ED visits.

3.5.1 Limitations

There are several limitations in this study that should be noted. Our definition of a regular HCP does not specify if the regular HCP is a primary healthcare provider; for example, a respondent's regular HCP could be a specialist or someone to whom the respondent had been referred to from the primary healthcare level. Since the CCHS survey question

about preventable ED visits referred to the regular HCP as a primary care provider and primary healthcare in Canada acts as a first-contact health service [66], we determined that a regular HCP sufficiently encompassed primary healthcare. Our definition of a regular HCP also does not provide information on whether respondents had a continuity of care or their trust, confidence, and satisfaction with their regular HCP, which could have influenced their decisions to visit the ED. Our outcome variable, preventable ED visits, was only recorded as the respondent's last ED visit rather than among all their ED visits in the past year. In addition, it was not possible to establish causal inferences in our associations due to the cross-sectional nature of the CCHS. Self-reported data are also subjected to limitations including recall bias or social desirability bias. We were unable to verify the accuracy of respondents' self-reported ED visit (i.e. whether they actually visited the ED in the past year), which in turn may affect our estimates for the proportion of ED visits that are preventable and for the associations between the patient characteristics and preventable ED visits. There may also be underreporting for more sensitive survey questions and variables, such as whether respondents had a certain chronic condition or for the health behaviour questions. Furthermore, while the use of sampling weights in our analyses allowed for our estimates to be representative of the broader population, our findings are not generalizable to those who were excluded from the CCHS's target population. Lastly, we were unable to include a number of important factors that were in Andersen's Behavioural Model such as unmet healthcare needs, health beliefs, knowledge of health services, or rurality because these variables were not included in the PUMF or were not collected in all provinces and territories.

3.5.2 Implications

Despite these limitations, our study has several implications for healthcare policies. In 2015-2016, approximately 40% of adults in Canada who had a regular HCP and visited the ED at least once in the past year considered their last visit to be preventable. Our study demonstrated that, in a population with universal healthcare coverage and who have a regular HCP, a sizeable proportion of ED visits were related to issues regarding availability and timely access to their regular HCP, and that there are underlying barriers that impede patients' ability to actually access and receive care when the need arose. As

well, our study demonstrated that sub-populations such as those with low education, low total household income, and ethnic minorities have higher odds of having a preventable ED visit, suggesting that they face health inequalities and disparities that further hinder their ability to receive timely care from their regular HCP. Healthcare policies that target improving the availability and accessibility of primary healthcare to these sub-populations may assist in reducing preventable ED visits and improving their overall health and wellbeing. Furthermore, our findings on the association between self-rated mental health and preventable ED visits indicate that there is a need to improve the delivery of mental health care in primary care settings. Strategies that focus on providing better support, health education, and healthcare resources to patients with poorer mental health or who have mental health illnesses would assist in improving their perceptions of their health, provide them with the knowledge and skills of how to better self-manage their health, and assist in reducing preventable ED visits. As well, healthcare policies that improve the accessibility to primary healthcare for this sub-population would provide opportunities for patients to foster a continuity of care with their HCP and to receive more specialized, long-term care in more appropriate settings.

This study also has implications for future research. Future studies that investigates preventable ED visits among those who have a continuity of care with their regular HCP would provide additional insight into barriers to primary healthcare that are experienced by these patients and driving factors for their decisions to visit the ED. As well, future studies that include geographic factors such as rurality, physician density, or proximity to hospitals or primary healthcare would allow researchers to employ multi-level modelling or spatial analysis techniques to explore geographic variations in preventable ED visits across Canada. As well, incorporating contextual factors such as neighbourhood-level SES would provide more information on how community-related factors affect access to health services and ED use. Finally, use of health administrative databases linked to CCHS could provide a different perspective on preventable ED visits, as patients' self-reported ED visit and their self-reported preventable ED visit could be compared to ED visits that are recorded in the databases, their triage score, chief complaint, or discharge diagnosis.

3.5.3 Conclusion

In 2015-2016, approximately 40% of adults in Canada who had a regular HCP and at least one ED visit in the past year considered their last visit to be preventable. Key correlates of preventable ED visits included younger age, female sex, low education level, being employed, non-white ethnicity, low total household income, having no consultations with a medical doctor in the past 12 months, having a strong sense of community belonging, and worse self-rated mental health. Our study demonstrated that, despite having universal healthcare coverage and a regular HCP, individuals still experienced barriers to primary healthcare that were related to lack of availability and timely access to their regular HCP for immediate care. The key correlates identified in our study indicate that certain sub-populations such as those of low education level, low total household income, and ethnic minorities face disproportionally higher barriers to care and health inequalities that affect their ability to receive care from their regular HCP and increase their likelihood of seeking care in EDs instead. Healthcare policies that target improving the delivery of primary healthcare to these sub-populations would assist in lowering the volume of preventable ED visits. Future studies that investigate the key correlates identified in our study as well as additional geographic and contextual factors would further our understanding of preventable ED visits and assist in developing healthcare policies that enhance the delivery of healthcare.

3.6 Financial Disclosure Statement

The authors received no specific funding for this work.

3.7 Conflicts of Interest

All authors declare that they have no conflicts of interest.

3.8 References

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Chapter 4

4 Discussion and Conclusion

This chapter provides a summary of the systematic review (Chapter 2) and quantitative study (Chapter 3) and synthesizes the key findings of these studies in the context of the broader literature. The strengths and limitations of these studies are also discussed, as well as directions for future research.

4.1 Goal of Thesis

Emergency department (ED) visits for reasons or conditions that could be treated or appropriately managed in primary care settings are considered to be preventable [1-3]. High rates of preventable ED visits are indicative of underlying health inequalities and barriers to primary healthcare [4-7], which is especially concerning as Canadians are guaranteed universal healthcare coverage and access to health services without financial or other barriers [8]. It is crucial to gain a better understanding of the magnitude of preventable ED visits in Canada and to identify the correlates of these visits to develop tailored, more targeted healthcare policies to reduce these visits and improve access to and delivery of primary healthcare. The overarching goal of this thesis was to contribute to the body of Canadian research on preventable ED visits by exploring the prevalence of preventable ED visits among adults in Canada and identifying the key correlates of these visits among a broad range of patient characteristics and factors. To accomplish this, we conducted two interrelated studies. First, we conducted a systematic review to synthesize the literature on preventable ED visits in Canada, to gain a better understanding of the current evidence, and to identify gaps in the literature. The findings of our systematic review were then used to inform our second study, which was a population-based quantitative analysis that used data from the 2015-2016 Canadian Community Health Survey (CCHS) to elucidate the key correlates of self-reported preventable ED visits among adults in Canada who have a regular healthcare provider (HCP).

4.2 Summary of Studies

4.2.1 What are the Determinants of Preventable Emergency Department Visits? A Systematic Review of the Literature

The objective of the systematic review was to investigate the prevalence of preventable ED visits among adults in Canada and the patient-related factors associated with these visits. After conducting the systematic literature search and study screening, a total of 17 studies (15 peer-reviewed studies, one health report, and one conference abstract) were included in our systematic review. Most of the studies were cross-sectional studies that used data from patient surveys and questionnaires that were administered in hospital EDs (n = 9). In total, four types of criteria were used to identify preventable ED visits: the Canadian Triage and Acuity Scale (CTAS), family practice sensitive conditions (FPSCs), ambulatory care sensitive conditions (ACSCs), and sentinel non-urgent conditions (SNCs). Of these four criteria, CTAS was most commonly used; however, studies varied in the methodology used to identify preventable ED visits. Some studies only included ED visits that were triaged as CTAS levels IV (less urgent) or V (non-urgent), while others included higher levels of CTAS (representing greater patient severity and acuity) or used a combination of CTAS with FPSC diagnoses. After synthesizing the findings from the included studies, we found that the prevalence of preventable ED visits among the general adult population ranged from 4.3% to 59.1%, with a median of 22.5%. This wide range was largely due to the differences between studies in the methods used to identify which ED visits were preventable and the context in which preventable ED visits were explored. In particular, the lowest estimate (4.3%), reported by Alsabbagh *et al.*, had the most restrictive definition and method for identifying preventable ED visits as the authors first identified ED visits that were triaged as CTAS ≥ IV and diagnosed with a FPSC; then, within these visits they identified those that were diagnosed with a subset of FPSCs that could be potentially managed by pharmacists within an expanded scope of practice [9]. In comparison, the highest estimate (59.1%), reported by Khan *et al.*, was less restrictive and identified preventable ED visits as less urgent ED visits that were triaged as CTAS ≥ IV [10].

For the second objective of our systematic review, we categorized the patient-related factors that were reported in the reviewed studies into three groups: (1) access to primary healthcare, (2) sociodemographic characteristics, and (3) patient health status. Most of the patients within the included studies had a source of primary healthcare – with the most common type being a family physician (FP) – yet they experienced barriers in accessing these health services. These barriers were namely the lack of availability and timely access to their HCP, which included being unable to contact their HCP, their HCP's office was closed, being unable to obtain an appointment in a timely manner, or long wait times at their HCP's office. Other key factors that contributed to patients' decisions to seek care in EDs instead of in primary care settings included the perceived urgency and severity of their symptoms, need for immediate care, and more favourable impressions of EDs in terms of convenience, accessibility, and quality of care compared to primary healthcare. In terms of sociodemographic characteristics and patient health status, preventable ED visits were associated with younger age, low education level, low income, rural residence, and worse self-rated health. Other factors that were explored but had no reported associations or inconclusive results included: employment status, ethnicity, health behaviours, immigration status, living arrangements, marital status, sex, and sexual orientation.

While the overall risk of bias of the included studies was moderate-to-low, the strength of evidence was limited by the study design and methodological quality of the included studies. Most of the studies were cross-sectional studies that used data from patient questionnaires that were administered in hospital EDs, which are limited in their generalizability to the broader population. The majority of the studies only reported the descriptive statistics of the patients, and only four studies conducted regression analyses to control for potential confounding variables when assessing the associations between patient-related factors and preventable ED visits. Nevertheless, our systematic review was the first to synthesize the research on preventable ED visits in Canada and provided valuable insight into the Canadian evidence base. Our systematic review also identified several gaps in the literature. First, there is a need for more population-based studies of preventable ED visits to obtain results that are generalizable to the broader population. Second, there is a need for further research that incorporates more rigorous statistical

methodology to better estimate the associations between various patient-related factors and preventable ED visits. Third, we were unable to obtain conclusive results on the role of factors such as employment status, ethnicity, and immigration status due to the small number of studies that explored these factors. We believe that these factors, as well as those that we found to be associated with preventable ED visits, are good candidates for future research. Fourth, while the studies were heterogeneous in their methodology for categorizing ED visits, they all used objective measures to identify preventable ED visits. Using subjective measures to identify preventable ED visits could provide further insight into patients' perceptions of their ED visits and their decision-making processes for seeking care in EDs instead of in primary care settings. This is especially important as previous studies have found that patients and HCPs differ in their assessments of illness severity [11] and perspectives of what constitutes a non-urgent or preventable ED visit [12-14]. Lastly, a key finding of our systematic review was that patients' perceptions of their accessibility to primary healthcare played an important role in their decisions to seek care in EDs instead of in primary care settings. This is consistent with previous studies that have found that those who are able to actually receive care from their HCP when needed are less likely to have an ED visit [15-17] and that patients' perceptions of barriers to timely access to primary healthcare are an especially strong driver for their decisions to visit the ED instead of their HCP [18-21]. Overall, our systematic review suggested that there is a need for further investigation of preventable ED visits in the context of patients' perceptions of their visits and access to primary healthcare.

4.2.2 Preventable ED Visits in Canada: An Analysis of the 2015-2016 Canadian Community Health Survey

Our systematic review identified several patient-related factors that were associated with preventable ED visits and gaps in the literature that would benefit from further research. As previously noted, past Canadian studies have used objective measures to identify preventable ED visits, and preventable ED visits have been primarily defined based on the type of diagnosis or clinical acuity of the visit. There are no population-based Canadian studies that have used subjective measures to identify preventable ED visits, nor are there population-based Canadian studies that specifically investigated preventable

ED visits among those who have a regular HCP yet decided to seek care in the ED instead. Finally, there is a dearth of population-based research on preventable ED visits that extends beyond descriptive studies. Therefore, to address these gaps, we used data from the 2015-2016 CCHS to conduct a population-based quantitative analysis of self-reported preventable ED visits among adults in Canada with a regular HCP and to elucidate the key correlates of these visits.

Our study sample included adult respondents (age ≥ 18 years) who had visited the ED at least once in the past year and had a regular HCP (defined as a health professional that respondents would regularly see or talk to when they needed care or advice for their health). Our outcome was self-reported preventable ED visits, which was assessed as a binary variable and obtained from the survey question, "The last time you went to the emergency room, was it for a condition that you thought could have been treated by your primary care provider (i.e. regular HCP) if he/she had been available?" Our selection of patient characteristics to include in our analyses was guided by the patient-related factors identified in our systematic review as well as Andersen's Behavioural Model of Health Services Use, which was used to assist in selecting and organizing these characteristics. Based on this, the following patient characteristics were included in our analyses: pre-disposing characteristics (age, sex, education level, employment status, marital status, ethnicity, and immigration status), enabling characteristics (total household income, insurance for prescription medications, consultations with a medical doctor, and sense of community belonging), need characteristics (multimorbidity, self-rated general health, and self-rated mental health), and health behaviours (binge-drinking, smoking status, and illicit drug use). We conducted a series of univariable logistic regression analyses (unadjusted models) to assess the unadjusted association between each patient characteristic and preventable ED visits. Next, we conducted a multivariable logistic regression analysis (adjusted model) where all patient characteristics were simultaneously entered into the model to assess their independent association with preventable ED visits while controlling for the effects of the other variables in the model.

Based on the estimates from our nationally representative sample, 39.9% of adults who had at least one ED visit in the past year and had a regular HCP considered their last ED

visit to be preventable (i.e. their last visit was for a condition that they thought could have been treated by their regular HCP if he/she had been available). In our unadjusted models, all patient characteristics were statistically significant except for education level, self-rated mental health, smoking status, and illicit drug use. In our adjusted model, education level, self-rated mental health, and illicit drug use became significant, while marital status, insurance for prescription medications, and binge-drinking became non-significant and smoking status remained non-significant. Therefore, the results from the adjusted model indicated that preventable ED visits were significantly associated with younger age, females, low education level, being employed, non-white ethnicity, low total household income, having no consultations with a medical doctor in the past 12 months, having a strong sense of community belonging, and worse self-rated mental health. Those who were not born in Canada (non-permanent residents or landed immigrants), were multimorbid, had worse self-rated general health, and used illicit drugs were significantly less likely to have a preventable ED visit.

4.3 Synthesis of Key Findings

Together, our findings from the systematic review and quantitative study provide valuable insight into preventable ED visits in Canada. Our estimate of the proportion of ED visits in Canada that were preventable was higher than the median prevalence in our systematic review (39.9% vs. 22.5%) but was still within the range of estimates reported in the literature (4.3% to 59.1%). It should be noted, however, that our quantitative study measured preventable ED visits as the respondents' last ED visit. It is also a fairly conservative estimate since we excluded those who do not have a regular HCP, and previous studies have found that those without a usual source of care use ED services at disproportionately higher rates [22-24]. The wide range and differences between the estimates that were reported in the studies included in our systematic review emphasize the variations in how preventable ED visits are operationalized across different studies. This is a pervasive problem in the literature, as multiple studies have noted that there is no universal definition for preventable ED visits and a lack of consensus on the criteria and methodology that should be used to identify these visits, which often lead to conflicting results that suffer from a lack of reproducibility and reliability [12, 25]. It

should also be noted that CTAS, ACSCs, FPSCs, and SNCs are proxy measures for preventable ED visits and have their strengths and limitations (see Appendix D for more information about these criteria). While CTAS has been extensively studied and validated in multiple studies and across different settings [26-29], its primary purpose is to provide benchmark time targets to physician assessment, as well as to quickly assess the severity and acuity of the patient's presenting illness and to process and stream them to appropriate treatment and care [30, 31]. The CTAS was not designed to identify the appropriateness of ED visits and has been recommended against being used as a tool to identify non-urgent patients who could be diverted away from the ED and managed in other settings [31, 32]. ACSCs, FPSCs, and SNCs were developed as indicators for access and quality, appropriateness, and integration of primary healthcare, respectively [33-36]. While ACSCs are more widely recognized in the literature, they are also limited as they do not provide information on the underlying mechanisms that drive variations in the trends and rates of ACSCs [34] and do not consider the complexity of socioeconomic, cultural, individual, and health service delivery factors which may influence health and healthcare-seeking behaviours [37]. FPSCs were developed specifically based on the diseases or conditions that were the cause of Alberta ED or urgent care visits in 2006-2007 [35]; however, this list has not been validated and it is unknown if they can be applied to other geographic regions outside of Alberta. Similarly, the list of SNCs has not been validated and it was also noted that the indicator was designed to be specific rather than sensitive and does not capture all conditions that could be treated in alternative primary care settings [36, 38]. Our study highlighted that "preventable" is an umbrella term; there is a need to develop a more comprehensive measure for these visits and a standardized methodology for identifying preventable ED visits in order to better understand the pathways from which they arise and their relationship with primary healthcare.

In both of our studies, we found that, in Canada, age, education, and income were significant correlates of preventable ED visits. This, along with similar findings from studies in other countries [39-43], suggests that younger age, low education level, and low income are consistently associated with a higher likelihood of having a preventable ED visit. Health interventions – such as strategies to improve health literacy, providing

patient education on how to self-manage one's health and health conditions, or providing resources on alternative sources of care outside of the ED – that target these populations may be especially effective in lowering high volumes of preventable ED visits and improving overall population health. While our systematic review found conflicting and inconclusive results for the association between sex and preventable ED visits, our quantitative study found that females had higher odds of having a preventable ED visit than males. Although our systematic review found no reported associations between preventable ED visits and employment status, ethnicity, and immigration status, our quantitative study found that preventable ED visits were independently associated with being employed and non-white ethnicity, while those who were not born in Canada had a lower likelihood of having a preventable ED visit (with established landed immigrants having the lowest odds). It should be noted, however, that immigrant and ethnic minority populations are very heterogeneous and diverse in their country of origin, attitudes towards health, and use of health services [44-47]. Additional research that explores preventable ED visits within specific immigrant or ethnic sub-populations may provide further insight into the health disparities and barriers to primary healthcare that are experienced by these groups. Such research can also assist in developing more targeted healthcare policies that may lead to improvements in the delivery of healthcare to these sub-populations.

As a whole, health behaviours have been found to influence health status and healthcare-seeking decisions [48, 49] and are an important component to consider when exploring patterns of ED and health services use. In our systematic review, only three studies explored health behaviours (smoking, alcohol consumption, substance use, and having an influenza shot), and none of them conducted regression analyses to further assess whether these behaviours were associated with preventable ED visits. In our quantitative study, we included binge-drinking, smoking status, and illicit drug use and found that only illicit drug use was statistically significant in the adjusted model; specifically, those who used illicit drugs were less likely to have a preventable ED visit. In the broader literature, the prevalence of illicit drug use has been increasing around the world and represents a significant health burden in terms of economic costs and global morbidity and mortality [50, 51]. Furthermore, illicit drug use has been found to be associated with poorer health

[50], increased rates of ED utilization [52], and increased risk of hospitalization [53]. There is a need for further research that incorporates health behaviours in order to gain a more holistic understanding of how these factors affect health outcomes and the use of EDs and other health services.

Interestingly, our systematic review and quantitative study found somewhat contradictory results for self-rated health. In our systematic review, worse self-rated health was associated with higher odds of having a preventable ED visit. In our quantitative study, we included self-rated general health and self-rated mental health to represent perceived need, as these measures are able to capture aspects of overall health and mental health while also taking into account patients' subjective wellbeing and allowing them to evaluate different aspects of their health as a whole [54-56]. In our unadjusted models, only self-rated general health was statistically significant; specifically, those with worse self-rated general health were less likely to have a preventable ED visit. While this relationship persisted in the adjusted model, there was a change in significance for self-rated mental health as worse self-rated mental health became significantly associated with a higher likelihood of having a preventable ED visit. A potential explanation for these contradictory findings between our systematic review and quantitative study could be due to differences in how the construct of preventable ED visits was measured. In our systematic review, the studies identified preventable ED visits either at the time of the visit or retrospectively using data from health records or databases. On the other hand, preventable ED visits in our quantitative study were identified retrospectively based on the respondents' recall of their last ED visit and their perceptions of their health condition, ability of their regular HCP to treat their health condition, and availability of their regular HCP. In the broader literature, previous studies that have employed Andersen's Behavioural Model have found that need characteristics are often the strongest predictors of non-urgent ED visits [57, 58]. Furthermore, one study that specifically investigated non-urgent ED visits among those who had a regular HCP found that perceived need characteristics were the strongest determinants of these visits [59]. A potential explanation for the different directions of effect for self-rated general health and self-rated mental health in our quantitative study could be due to the nature of the survey question; since respondents were retrospectively asked about their ED visit, their recall of

their health condition and last ED visit may be more strongly affected by their mental health. Additional research on the associations between self-rated general health, self-rated mental health, and preventable ED visits is required to better understand the pathways through which they influence the use of EDs.

4.4 Strengths

There are several strengths to our systematic review. We searched a total of six databases, as well as grey literature on ProQuest, Web of Science, and SCOPUS. We consulted with an academic librarian in developing our search strategy, and our search strategy incorporated a combination of medical subject heading (MeSH) terms and keywords that had been used in previous systematic reviews and encompassed different aspects of preventable ED visits that have been previously explored in the literature. Because there is no universal or formal terminology and definition for preventable ED visits, we included other keywords and variations for preventable ED visits such as “inappropriate”, “non-urgent”, “non-emergent”, “avoidable”, and “unnecessary”, along with Boolean search modifiers to ensure that we captured variations of these keywords. Furthermore, we manually searched the reference lists of the studies included in our systematic review to ensure that potentially relevant studies were not overlooked. We were fairly inclusive in how we defined preventable ED visits for our systematic review since our goal was to obtain a broad overview of the Canadian evidence base in this area.

To our knowledge, our quantitative study was the first to explore self-reported preventable ED visits across all of Canada. Our use of data from a national population health survey allowed for a large sample size of respondents across all of Canada and we minimized missing data by only including variables that had been measured in all provinces and territories. As well, our use of sampling weights in the analyses ensured that our results were representative of the broader population. This differs from previous studies that used data from patient surveys conducted in hospitals, which are limited in their sample size and generalizability. As well, unlike previous studies that defined preventable ED visits based on clinical assessments of the patient’s acuity, urgency, or diagnosis of their visit, our measure and definition of preventable ED visits was self-reported and included aspects such as respondents’ perceptions of the urgency of their

health condition and how they perceived their regular HCP in terms of their availability and ability to treat their health condition. Furthermore, because our study specifically assessed preventable ED visits among those with a regular HCP, this allowed us to uniquely investigate the relationship between preventable ED visits and accessibility to primary healthcare in terms of timely access to care and patients' ability to actually receive care from a regular HCP when the need arose.

4.5 Limitations

There are several limitations in our systematic review that should be noted. At the level of the individual studies, a major limitation was the study design and methodological quality of the included studies. Most of the studies were cross-sectional studies that used data from patient surveys and questionnaires administered in hospital EDs, which have the potential for selection and response bias. The questionnaires were only available in English, and patients who could not read or communicate in English were excluded from these studies. There was also the potential for volunteer bias, as volunteers tend to be healthier and of higher socioeconomic status and education level [60]. As well, the willingness of patients to participate in the studies and their responses to the questionnaires could have been affected by factors such as their wait time in the ED or their level of pain and discomfort. For example, patients who had longer wait times or were in greater pain and discomfort may be less willing to participate or, if they chose to participate, they may have more negative or critical perceptions of their health and access to health services. Because these studies used data from patient surveys, they are limited in their sample size and generalizability to the broader population. At the level of our systematic review, it is possible that our search strategy was not able to capture all aspects of preventable ED visits due to the variations within the literature in how preventable ED visits have been conceptualized. As well, we were unable to quantitatively synthesize the data due to the heterogeneity in the methods used to identify preventable ED visits and in the reporting of the patient-related factors. Lastly, our risk of bias assessment tool (Newcastle-Ottawa Quality Assessment Scale) was originally developed for case-control and cohort studies, and we used an adapted version of this scale for the cross-sectional studies.

There are several limitations in our quantitative study that should be noted. While the use of CCHS data for our quantitative study allowed for a nationally representative sample that spanned across all of Canada, our findings are not generalizable to those who were excluded from the CCHS's target population, such as those who do not live in private dwellings, those living on reserves or Aboriginal settlements, full-time members of the Canadian forces, the institutionalized population, or those living in certain remote health regions. Our outcome variable (preventable ED visits) was measured as the respondent's last ED visit rather than among all their ED visits within the past year. Due to the inherent limitations of secondary data, we were unable to include key variables that had been identified in Andersen's Behavioural Model or in our systematic review such as health beliefs, knowledge of health services, or rurality because they were not included in the CCHS or were not asked in all provinces and territories. As well, due to the self-reported nature of the CCHS, there is the potential for recall bias or social desirability bias. We were unable to verify the accuracy of respondents' self-reported ED visit, which in turn may affect our estimates for the proportion of ED visits that are preventable and for the associations between the patient characteristics and preventable ED visits. In addition, because of the cross-sectional design of our study, we were unable to establish causal inferences in the observed associations. Our data were limited to the 2015-2016 CCHS as the survey question regarding preventable ED visits was not asked in the following years and, due to the CCHS undergoing major sampling and questionnaire re-designs in 2015, Statistics Canada cautions against comparing data from prior to 2015 to 2015 onwards [61]. Lastly, while our study focused on the relationship between patients' perceptions of their health condition, timely access to their regular HCP and their decisions to visit the ED, it is possible that the respondents' decision could have been driven by other factors such as trust, familiarity, confidence, previous patient experiences, or satisfaction with their regular HCP. Including unmet healthcare needs as a proxy for access to healthcare could have provided additional insight into the availability, accessibility, and acceptability of these services [62]; however, this variable was only asked to respondents who resided in Newfoundland and Labrador, Nova Scotia, Alberta, and Yukon. Alternatively, using consultations with a medical doctor as part of our study population inclusion/exclusion criteria could have allowed us to only select respondents

who had at least one consultation, as this may indicate that they have a continuity of care and greater satisfaction with their regular HCP. Since the objective of our quantitative study was to broadly explore preventable ED visits among those with a regular HCP, however, we decided against further restricting our population as this was outside the scope of our study. As well, further restricting our study population would have reduced our sample size and affected the statistical power of our analyses.

4.6 Directions for Future Research

Despite these limitations, this thesis provided new information about preventable ED visits in Canada and there are several potential directions for future research. Qualitative studies that further explore patients' perceptions and reasons for their ED visit would provide more in-depth information on their decision-making processes for seeking care in EDs. As well, longitudinal studies that investigate whether there have been changes in the rates of overall ED visits and preventable ED visits over time would provide information on temporal trends and whether patterns of ED visits differ within and between populations over time. Because our quantitative study only explored preventable ED visits among those who reported having a regular HCP, future studies could explore whether the proportion of preventable ED visits or correlates of these visits differ among patients who have an ongoing continuity of care relationship with their regular HCP. Due to Canada's unique geography, future research that investigates variations in preventable ED visits based on rurality or by province or territory could provide additional insight into geographic health inequalities or how geographic regions differ in the organization, delivery, and use of health services. While our studies broadly explored preventable ED visits across Canada, it would be of interest to explore preventable ED visits within more specific sub-populations, such as among vulnerable sub-populations or specific cultural or ethnic groups. This would assist in developing more tailored healthcare policies and strategies to reduce ED volumes and address barriers to healthcare and health inequalities experienced by these specific sub-populations. Lastly, future studies that consider using data from the CCHS that has been linked to administrative databases such as the National Ambulatory Care Reporting System (NACRS) would allow researchers to verify the accuracy of self-reported ED visits with ED visits that were recorded in the

administrative databases, compare estimates that are obtained from survey data to estimates that are obtained from administrative databases, incorporate other data elements from the administrative databases that are not in the CCHS, and develop a more comprehensive measure of preventable ED visits.

4.7 Conclusion

The goal of this thesis was to contribute to the body of Canadian research on preventable ED visits by exploring the prevalence and key correlates of these visits among adults in Canada. Our first study, a systematic review of the literature on preventable ED visits in Canada, found that the prevalence of these visits among the general adult population ranged from 4.3% to 59.1%. A key theme of our systematic review was access to primary healthcare; although most patients had a source of primary healthcare or a regular HCP, they experienced barriers to being able to actually access and obtain care. These barriers, coupled with perceptions of urgency, need for care, and more positive perceptions of EDs in terms of convenience, accessibility, and quality of care compared to primary healthcare, were driving factors for their decisions to seek care in EDs instead of in primary care settings. Preventable ED visits were also associated with younger age, low education level, low income, rural residence, and worse self-rated health. To extend the findings of our systematic review and address the gaps in the literature, we conducted a second study to quantitatively assess and identify the key correlates of self-reported preventable ED visits among adults in Canada with a regular HCP. Using secondary data from the 2015-2016 CCHS, we found that among adults who had at least one ED visit in the past year and had a regular HCP, 39.9% considered their last ED visit to be preventable. Key correlates of these visits included younger age, female sex, low education level, being employed, non-white ethnicity, low total household income, having no consultations with a medical doctor in the past year, having a strong sense of community-belonging, and worse self-rated mental health.

Overall, the findings from this thesis indicate that preventable ED visits are a major healthcare concern in Canada that warrants further attention from researchers and healthcare policymakers. These visits comprise a sizeable proportion of all ED visits in Canada, contributing to the increased demands and pressures that are faced by EDs and

the Canadian healthcare system. As well, they also indicate underlying problems in the delivery of primary healthcare in terms of timely access and quality of care. Both of our studies found that younger age, low education level, and low income were consistently associated with a higher likelihood of having a preventable ED visit. In addition to this, our quantitative study identified other key correlates that were not identified in our systematic review or which had inconclusive evidence and provided further insight into the relationship between preventable ED visits and these correlates. These findings indicate that certain sub-populations are more likely to have a preventable ED visit, suggesting that they face disproportionately greater barriers to primary healthcare that impacts their health and use of health services. Due to the exploratory nature of our thesis, however, further research is required to generate more evidence to inform healthcare policies and decisions. Futures studies that uses CCHS data in conjunction with health administrative databases would allow researchers to incorporate the clinical information within these databases with the self-reported measures of preventable ED visits. Together, these data elements could be used to develop a more comprehensive measure for preventable ED visits and better understand the association between these visits and different dimensions of health quality and health services use. As well, additional research that explores the correlates of preventable ED visits within specific sub-populations would assist healthcare policymakers in better understanding the health inequalities and healthcare needs of these sub-populations and in developing more targeted policies to improve their access to primary healthcare and overall health. In conclusion, this thesis significantly contributed to the body of Canadian research on preventable ED visits and identified several key correlates of these visits. Future studies that incorporate contextual and geographic factors, use a longitudinal study design, or take advantage of administrative databases would provide further insight into the determinants and variations in preventable ED visits.

4.8 References

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Appendices

Appendix A: PRISMA Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	24
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	24
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	25
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	25
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	26
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	26
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	26
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	139 (Appendix B)

Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	26-27
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	27
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	27
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	27-28
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	27
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	27
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	-
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	-
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	28-29
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	30-33
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	62-65
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	34-61
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	-

Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	-
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	-
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	66-68
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	68-69
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	70
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	70

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

Appendix B: Search Strategy for MEDLINE

1	exp Emergency Medical Services/
2	exp Emergency Service, Hospital/
3	((((((((((((emerg* adj3 department*) or emerg*) adj3 room*) or emerg*) adj3 ward*) or emerg*) adj3 unit*) or emerg*) adj3 visit*) or emerg*) adj3 utili*) or emerg*) adj5 service*).ti,ab,tw.
4	exp patient acuity/
5	exp health services misuse/
6	(preventable or nonurgent or urgent or nonemerg* or avoid* or appropriate or inappropriate or misuse or unnecessary or acuity).ti,ab,tw.
7	(health adj3 misuse).ti,ab,tw.
8	(patient adj3 acuity).ti,ab,tw.
9	exp CANADA/
10	Canad*.ti,ab,tw.
11	1 or 2 or 3
12	4 or 5 or 6 or 7 or 8
13	9 or 10
14	11 and 12 and 13

Appendix C: Inclusion/Exclusion Criteria for Study Screening and Selection

PICOS Component	Inclusion Criteria	Exclusion Criteria
Population (Adults in Canada ages 18 or older)	• Studies that included the adult population in Canada (age ≥ 18 years).	• Studies conducted outside of Canada or used non-Canadian data sources. • Studies that exclusively investigated patients younger than 18 (i.e. paediatric studies). • Studies that exclusively investigated refugees, those who used drugs, and/or homeless adults.
Comparison (Overall ED visits)	• ED visit was recorded in health administrative databases, survey data, or patient health records. • (1) Studies on the patients' social determinants of health, sociodemographic characteristics, or individual/community-level characteristics that are associated with ED use AND/OR • (2) Studies that investigated trends in ED use over time AND/OR • (3) Studies on geographic variation (urban vs. rural, inner city etc.).	

Outcome (Preventable ED visits)	• (1) ED visit (identified by the authors of the study being screened) that could have been treated or managed by a primary care provider AND/OR • (2) Study used a list of diagnoses or conditions to identify the visit as being primary healthcare-treatable AND/OR • (3) Utilized a triage system to classify patients as low acuity or non-urgent AND/OR • (4) ED visit was self-reported or perceived by patients or physicians as preventable AND/OR • (5) Study used a criteria or method not listed above but was described within the study.	• Study outcome was not preventable ED visits. • Did not distinguish preventable ED visits from overall ED visits • Did not state the criteria or method used to identify preventable ED visits. • Did not include data on the patients' social determinants of health, sociodemographic characteristics, and/or individual/community-level characteristics.
Study Design	• Observational studies (case-control, cross-sectional, cohort, mixed-methods etc.).	• Case-series, case-reports, reviews, studies on focus groups, commentaries, letters, editorials, opinion pieces
Other	• Grey literature (theses, dissertations, unpublished studies, government reports, health organization reports, abstracts, conference proceedings etc.). • No restrictions on year of publication. • No restrictions on language of publication.	

ED: emergency department

Appendix D: Criteria for Identifying Preventable Emergency Department Visits

In our systematic review (Chapter 2), we identified four types of criteria that had been used in previous studies to identify preventable emergency department (ED) visits: the Canadian Triage and Acuity Scale (CTAS), ambulatory care sensitive conditions (ACSCs), family practice sensitive conditions (FPSCs), and sentinel non-urgent conditions (SNCs). This Appendix describes these criteria in greater detail.

Canadian Triage and Acuity Scale (CTAS)

The CTAS was developed by the Canadian Triage and Acuity Scale National Working Group (CTAS NWG), which was formed in collaboration with the Canadian Association of Emergency Physicians (CAEP), the National Emergency Nurses Association (NENA), l'Association des médecins d'urgence du Québec (AMUQ), the Canadian Paediatric Society (CPS), and the Society of Rural Physicians of Canada (SRPC) [1-3]. The CTAS was introduced in 1999 and since then has been implemented and used in all hospitals in Canada [3, 4]. It has been extensively studied across different population groups and in different settings, and is a valid and reliable measure of patient acuity and use of medical resources [5-10]. Because of this, the CTAS is also used as a proxy measure for ED quality of care and performance [7]. The primary operational objective of CTAS is to provide benchmark target times to physician assessment, as well as to quickly and accurately assess patients' severity and need for medical attention, prioritize and stream patients to appropriate treatment areas, and to allow for more efficient allocation and use of ED resources [1-3].

The CTAS is comprised of five levels: level I (resuscitation), II (emergent), III (urgent), IV (less urgent), and V (non-urgent) [1-3]. Assignment of triage level is based on a number of factors including the patients' presenting complaint, the healthcare provider's initial assessment of the illness severity, 1st order modifiers (vital signs, pain scales, and mechanism of injury), and 2nd order modifiers (used for certain complaints or to supplement 1st order modifiers when they are inadequate to assign acuity) [1-3].

(1) **CTAS Level I (Resuscitation):** Conditions that are threats to life or limb (or imminent risk of deterioration), requiring immediate aggressive interventions [2].

(2) **CTAS Level II (Emergent):** Conditions that are a potential threat to life, limb, or function and which require rapid medical intervention or delegated acts [2].

(3) **CTAS Level III (Urgent):** Conditions that could potentially progress to a serious problem requiring emergency intervention and may be associated with significant discomfort or affecting ability to function at work or activities of daily living [2].

(4) **CTAS Level IV (Less urgent):** Conditions that are related to patient age, distress, potential for deterioration, or complications that would benefit from intervention or reassurance within 1-2 hours [2].

(5) **CTAS Level V (Non-urgent):** Conditions that may be acute but non-urgent as well as conditions which may be part of a chronic problem with or without evidence of deterioration [2]. The investigation or interventions for some of these illnesses or injuries could be delayed or even referred to other areas of the hospital or healthcare system [2].

Lastly, paediatric EDs use a different version of the CTAS, called the Canadian Paediatric Triage and Acuity Scale (PaedCTAS). This takes into account differences between the paediatric and adult population in their size, development, illness presentation, physiological parameters, and need for medical care [11].

Ambulatory Care Sensitive Conditions (ACSCs)

ACSCs are defined as conditions for which timely and effective primary healthcare could prevent or reduce the risk of hospitalization by either preventing the onset of the illness, controlling the acute illness episode, or managing a chronic condition or disease [12]. ACSCs are widely used as a measure of access to and quality of primary healthcare [12-14] and, while originally developed to identify preventable hospitalizations, have also been used as a measure of preventable ED visits [15-17]. The ACSCs are identified using

International Classification of Diseases (ICD) codes and were originally developed for the general adult population, but a subset of ACSCs was validated for the long term care population [18, 19]. These conditions include: angina pectoris, asthma, pneumonia, cellulitis, congestive heart failure, chronic obstructive pulmonary disease, dehydration, diabetes mellitus, gastroenteritis, grand mal status and epileptic convulsions, hypertension, hypoglycemia, kidney and urinary tract infections, and severe ear, nose, and throat infections [18, 19].

Family Practice Sensitive Conditions (FPSCs)

FPSCs were developed by the Health Quality Council of Alberta (HQCA) as a measure of the appropriateness of ED use [20]. They are defined as ED visits for conditions that could be appropriately managed at a family physician's office [20]. Similar to ACSCs, they are identified using ICD codes; however, they differ as ACSCs refer to chronic conditions whereas FPSCs refer to minor medical conditions [18]. Furthermore, FPSCs were developed specifically based on the diseases or conditions that were the cause of Alberta ED or urgent care visits in 2006-2007 and for which the probability of admission as an inpatient was less than 1% [20]. The full list of FPSCs is available from the HQCA upon request and includes conditions such as chronic sinusitis, migraine, and scabies [18, 21].

Sentinel Non-urgent Conditions (SNCs)

SNCs were developed by the Ontario District Health Councils Local Health System Monitoring Technical Working Group as an indicator for the integration of health services and continuity of care in Ontario [22]. These include conditions that may be treated in alternative primary care settings among the population between ages 1 to 74, and excludes ED visits that were triaged as CTAS I-III, scheduled or planned ED visits, or ED visits that resulted in inpatient admission [22]. The SNCs are identified using ICD codes and include: otitis media, cystitis, upper respiratory infections (common cold, acute or chronic sinusitis and tonsillitis, acute pharyngitis, laryngitis or tracheitis, and other upper respiratory infections), and conjunctivitis [22, 23]. Of note, the SNC indicator was

designed to be specific rather than sensitive and does not capture all conditions that could be treated in alternative primary care settings [23].

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Appendix E: Detailed Methodology for Chapter 3

This Appendix provides supplementary information for the methodology used in our quantitative study (Chapter 3). Additional information is provided on our data source, sampling design, and the data collection process, as well as the measures and variables used in our study. We also provide additional information on the procedures used to account for the missing data in our study, multicollinearity diagnostics, sampling weights, statistical analysis, and statistical software. We adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines in the reporting of our study methods [1] (Appendix F).

Data Source

Our second study (Chapter 3) was a quantitative, population-based analysis of secondary data from the 2015-2016 Canadian Community Health Survey (CCHS) public use microdata file (PUMF). The CCHS is an annual cross-sectional national population health survey that was developed by Statistics Canada, Health Canada, and the Canadian Institute for Health Information (CIHI) [2, 3]. Survey data collection for the CCHS began in 2001 as a two-year cycle; however, starting in 2007 the CCHS began to collect data annually [2, 3]. In 2015, the CCHS implemented a new sampling methodology and data collection strategy, as well as major revisions to the contents of the questionnaire [2, 3]. As a result, Statistics Canada cautions against comparing data from cycles prior to 2015 to data from 2015 onwards [2, 3].

The CCHS produces three types of microdata files: master files, share files, and PUMFs [3]. The master files contain all variables, personal identifiers, records from the collection period, and may be accessed through the Statistics Canada Research Data Centre (RDC) after approval from the RDC program [3]. The share files contain all variables included in the master file and records of respondents who agreed to share their data with partners of Statistics Canada (provincial and territorial health departments, Health Canada, and the Public Health Agency of Canada (PHAC)), and removes personal identifiers to ensure respondent confidentially [3]. Lastly, the PUMFs are developed from the master files and contain data collected over two years. The PUMFs are free of charge to access for

researchers and post-secondary educational institutions that are a part of the Data Liberation Initiative, which is a partnership between post-secondary institutions and Statistics Canada [3]. All PUMFs must undergo a formal review and approval process to ensure that they meet the security and confidentiality standards required by the *Statistics Act* before they are released for public access [3]. This includes removing variables that could lead to the identification of individuals or collapsing them into broader categories [3].

Ethical Approval

Ethical approval was not required for this study as respondents provided consent for their information to be collected and used by Statistics Canada at the time of their interview. Of note, we originally intended to use the master files from the 2015 and 2016 cycles of the CCHS, which are accessed through the RDC located at the University of Western Ontario; however, because the RDC and campus buildings were closed in March 2020 due to COVID-19, we were unable to complete our analysis and used the PUMFs for this thesis instead.

Content of CCHS

The purpose of the CCHS is to collect information related to health status, healthcare utilization, and health determinants for the Canadian population [2, 3]. This information includes subjects related to chronic diseases and health conditions, overall health, mental health and well-being, health care services, lifestyle, and social conditions [2, 3]. The CCHS has four primary objectives: (1) to support health surveillance programs by providing data at the national, provincial, and health region (HR) level; (2) to provide a single data source for all research on small populations and rare characteristics; (3) to provide timely release of information that is easily accessible to a diverse community of users; and (4) to create a flexible survey instrument that includes a rapid response option to address emerging issues related to the health of the population [2, 3]. To meet these objectives, the CCHS is comprised of four content components: core content, theme content, optional content, and rapid response content [3]. Core content includes questions asked to respondents in all provinces and territories [3]. Theme content is comprised of

groups of questions or modules related to a specific topic and is collected over a period of one or two years [3]. Optional content is chosen by provincial or territorial stakeholders in coordination with HRs and only asked in the provinces or territories that selected these modules [3]. This allows provinces and territories to select content that addresses their own public health priorities and to fulfill their own unique data needs [3]. Statistics Canada and CCHS noted, however, that results obtained from the optional content are not generalizable across all of Canada since they are only applicable to the selected provinces and territories [3]. The rapid response content is only asked to respondents living in the 10 provinces over a period of three to six months and is offered to organizations that are interested in obtaining national estimates on a specific or emerging health issue [3].

Because the PUMF contains data that are collected over two years, it includes questions that were part of the core content, two-year theme content, and two-year optional content [3]. To be able to generalize our results across all of Canada and minimize the missing data in our study, we only included variables obtained from survey questions that were asked to all provinces and territories.

Target Population

The CCHS includes data collected from individuals ages 12 or older living in private dwellings in all provinces and territories of Canada [2, 3]. It excludes people living on reserves or other Aboriginal settlements, full-time members of the Canadian Forces, individuals between ages 12 to 17 living in foster homes, the institutionalized population, and those living in the Québec HRs of Région du Nunavik and Région des Terres-Cries-de-la-Baie-James. These exclusions represent approximately 2% of the target population [2, 3].

Sampling Design

For sampling and administrative purposes, the provinces are divided into HRs while each territory is treated as a single HR [2, 3]. The CCHS uses a multi-stage sample allocation strategy to give relatively fair sample distribution across Canada [2, 3]. In the first step, provinces and territories are treated separately and a minimum of 500 respondents per

HR is allocated to ensure reasonable data quality, with a sample of 117,000 respondents allocated to the provinces and 3,000 respondents allocated to the territories using a 0.75 power allocation based on the size of the province's population [2, 3]. Then, within each province, the sample is allocated among the HRs using a power allocation of 0.35, based on the size of the HR's population [2, 3].

The CCHS uses two sample frames: a list frame created from the Canadian Child Tax Benefit (CCTB) files for the youth population (ages 12 to 17), and an area frame used by the Canadian Labour Force Survey (LFS) for the adult population (ages 18 or older) [2, 3]. To minimize potential seasonal effects on the results, the sample size for each frame (list frame for youth population and area frame for adult population) is equally allocated over 3-month collection periods throughout the year [3].

For the youth population, the list frame is created from the CCTB files, which includes the youths' address and contact information [2, 3]. Each youth is assigned an HR based on their address and then stratified by HR [2, 3]. Youths are then selected within each HR by simple random sampling (SRS) to complete the survey [2, 3]. For the adult population, the LFS uses a two-stage stratified cluster sampling design, with dwellings as the sampling unit [2, 3]. In the first stage, geographic or socioeconomic strata are formed within each province, and each stratum contains 150-250 dwellings that are grouped together to create the clusters [3]. In the second stage, a list of the dwellings within each cluster are prepared, and individual dwellings are selected from this list by systematic sampling [2, 3]. Lastly, all individuals within each the selected dwellings are listed, and selection probabilities based on age and household composition are used to select an adult to complete the survey [2, 3]. Of note, Prince Edward Island uses an SRS design instead of the two-stage stratified cluster sampling design [3]. As well, the LFS area frame sampling design for the territories is slightly different; within each territory, the larger communities have their own stratum, while smaller communities are grouped together based on population, geographic information, the proportion of Inuit and/or Aboriginal persons, and median household income [3]. For the larger communities, households are directly selected using the same strategy previously described [3]. For the smaller communities that are grouped together into strata, a community is randomly

selected with the probability proportional to the population size within the strata. Then, a household is selected within the community using the same strategy previously described [3].

Data Collection and Processing

Several strategies are used to initiate contact with the respondents and to minimize non-responses. Prior to the start of the collection period, letters with information about the purpose and importance of the survey are sent to the dwellings that have been selected for the interview [3]. Interviewers are also instructed to make reasonable attempts to contact the selected respondent, such as rescheduling the interview to a more convenient time if needed, call-backs at different times and on different days, and in-person visits if unable to contact the respondent through telephone [3]. For those who refuse to participate, another letter is sent to emphasize the importance of participating in the survey and calls or visits from a senior interviewer or supervisor are attempted to convince the respondent to participate [3]. Furthermore, while the interview is offered in English or French, interviewers with different language skills are also recruited and may assist in conducting the interview when needed [2, 3].

Data are collected using computer-assisted interviewing (CAI) applications [2, 3]. Use of CAI applications allows for customized interviews for each respondent based on their age, sex, date of interview, and responses to previous questions [3]. The CAI applications also ensure that questions that are not applicable to the respondent are automatically skipped [2, 3]. Furthermore, the CAI applications edit the data collected during the interview to check for inconsistent or unusual responses, out-of-range values, or invalid entries [2, 3]. Immediate feedback is given to the respondent, and the interviewer is able to correct for any inconsistencies [3]. The CCHS collects data using two separate CAI applications: computer-assisted telephone interviews (CATI) or computer-assisted personal interviews (CAPI) [3]. All youth respondents and approximately 75% of the adult respondents complete the interview using CATI [3]. During the interview, aside from the responses to the question, respondents may also answer “don’t know” or “refuse” [3]. Proxy reporting from another knowledgeable person in the household is

allowed in cases where the selected respondent is unable to complete the interview; however, certain questions that are more sensitive or personal may be skipped [3].

Additional data editing and processing also occurs after data collection at the Statistic Canada's head office [2, 3]. Responses of "not stated" are applied for inconsistent responses or when a question was skipped but could have been asked; either because the interview was completed by proxy or because a preceding question had a response of "don't know" , "refuse", or "not stated" [3]. Responses of "valid skip" are applied when a question was skipped because it did not apply to the respondent; either because it was an optional content question and the respondent did not reside in the province or territory for which that optional content was selected, or the question did not apply to the respondent and was skipped by the flow of the interview and questionnaire since it did not apply [3]. Derived variables are also created by either collapsing categories of a variable or by combining several variables to create a new variable [3].

Study Population

For our quantitative study, we included respondents ages 18 or older who reported visiting the ED at least once in the past 12 months and reported having a regular healthcare provider (HCP). A regular HCP was defined as a health professional that respondents would regularly see or talk to when they needed care or advice for their health [4]. We excluded respondents who did not visit the ED in the past 12 months and respondents who did not have a regular HCP. We also excluded respondents with missing data on one of the inclusion criteria; i.e., on whether they had visited the ED or had a regular HCP (responses of "don't know", "refuse", or "not stated"). Furthermore, proxy respondents were not included in our study as some of the variables used in our analyses were not collected from proxy interviews.

Measures

The variables chosen for our analysis are based on the findings from our systematic review of the patient-related factors associated with preventable ED visits (Chapter 2). We also employed Andersen's Behavioural Model of Health Services Use to assist in

selecting and organizing the variables. Appendix G presents a list of the variables included in our analysis.

Andersen's Behavioural Model was developed to assist policymakers and researchers in better understanding the use of health services, defining and measuring different dimensions of access to care, and to develop healthcare policies to promote equitable access to care [5]. According to Andersen's Behavioural Model, the use of health services is a function of an individual's pre-disposing, enabling, and need characteristics [5]. The model has undergone numerous revisions since its conception, and more recent iterations also include health behaviours to recognize and highlight that personal health practices may also influence an individual's health status, health outcomes, and use of health services [6, 7].

Outcome

The outcome of our study was self-reported preventable ED visits. This was assessed as a binary variable, obtained from the survey question, "The last time you went to the emergency room, was it for a condition that you thought could have been treated by your primary care provider (i.e. regular HCP) if he/she had been available?" Responses of "yes" meant that the respondent perceived their last ED visit to be preventable (i.e. the last time they went to the ED, it was for a condition that they thought could have been treated by their regular HCP if he/she had been available). Responses of "no" meant that the respondent perceived their last ED visit to be non-preventable (i.e. the last time they went to the ED, it was for a condition that they thought could not have been treated by their regular HCP if he/she had been available).

Pre-disposing Characteristics

Pre-disposing characteristics are factors that describe the propensity of individuals to use health services [5]. These include demographic and social factors, which represent biological imperatives that suggests the likelihood that people will need health services, and factors that determine the status of the individual in the community and their ability to cope with problems and utilize resources to deal with these problems [7].

The following pre-disposing characteristics were included in our analyses: age, sex, education level, employment status, marital status, ethnicity, and immigration status.

Age.

The age of the respondent was measured in years and derived from the respondent's date of birth and date of interview or, in some cases, by asking the respondent about their age. In the CCHS, age was reported as a categorical variable consisting of the following groups: ages 12-14, 15-17, 18-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, or ≥ 80. In our analysis, respondents ages 17 or younger were excluded and the remaining categories were collapsed into three groups: ages 18-44, 45-64, or ≥ 65. We collapsed the categories into three groups so that they represented young adults, middle aged adults, and senior adults, and to explore whether the association between age and preventable ED visits differed across these groups.

Sex.

The sex of the respondent was reported in the CCHS as male or female, and in our analysis sex was treated as a binary variable.

Education Level.

The highest education level attained by the respondent was reported in the CCHS as a categorical variable consisting of the following groups: less than secondary school graduation, secondary school graduation - no post-secondary education, and post-secondary certificate diploma or university degree. In our analysis, this variable was collapsed into two groups: less than secondary school (which represented low education level) or secondary school and beyond.

Employment Status.

We used two variables from the CCHS to determine employment status: whether the respondent had worked in the week prior to their interview and the respondent's working status. In our analysis, employment status was treated as a binary variable of employed (part-time or full-time), or unemployed.

Marital Status.

Marital status was reported in the CCHS as a categorical variable consisting of the following groups: married, common-law, widowed/divorced/separated, or single. In our analysis, we collapsed this variable into two groups: married/common-law (which represented representing marital and romantic attachment) or widowed/divorced/separated/single.

Ethnicity.

The cultural or racial background that respondents felt that they belonged to was reported as a categorical variable consisting of the following groups: white only and other racial/cultural groups (South Asian, Chinese, Black, Filipino, Latin American, Arab, Southeast Asian, West Asian, Korean, Japanese, other, or multiple racial/cultural origins). The CCHS did not include Aboriginal identity (First Nations, Métis, or Inuit) in this list because, according to the *Employment Equity Act*, Aboriginal peoples are considered to be a separate designated group [4] – thus, they were not asked about their cultural or racial background and were recorded as "valid skips." For our analysis, ethnicity was treated as a binary variable of white or non-white. Non-white ethnicities included the other racial/cultural groups and those of Aboriginal identity.

Immigration Status.

We used two derived variables from the CCHS to determine immigration status: whether the respondent was an immigrant and length of time since becoming a landed immigrant. In our analysis, we treated immigration status as a categorical variable consisting of the following groups: Canadian-born, non-permanent resident (NPR) or recent (0-9 years) landed immigrant, or established (≥ 10 years) landed immigrant.

Enabling Characteristics

Enabling characteristics describe the resources that individuals have which would allow them to access health services [5]. This includes financial resources, the organization of health services at the individual level, and social support [7]. Financial resources include

income, wealth, or other resources that are available for individuals to pay for health services [7]. At the individual level, organization of health services includes aspects such as whether an individual has a source of care, the nature of this source of care, transportation and travel time to this source of care, and wait time [7]. Social support represents the emotional and informational support from family, friends, and the community in times of need [7].

The following enabling characteristics were included in our analyses: total household income, insurance for prescription medication, consultations with a medical doctor, and sense of community belonging.

Total Household Income.

The respondent' total household income was measured in Canadian dollars, before taxes and reductions, and included income from all sources such as work, investments, pensions, or government. In the CCHS, this was reported as a categorical variable consisting of the following groups: < $20,000, $20,000-$39,999, $40,000-$59,999, $60,000-$79,999, or ≥ $80,000. In our analysis, we collapsed this variable into three groups: ≤ $39,999, $40,000-$79,999, or ≥ $80,000. We collapsed the categories into three groups so that they represented low, middle, and high total household income, and to explore whether the association between total household income and preventable ED visits differed across these groups.

Insurance for Prescription Medications.

In the CCHS, respondents were asked whether they had insurance (all or part coverage) for prescription medications. This was reported as a binary variable of yes or no.

Consultations with a Medical Doctor.

Consultations with a medical doctor in the past 12 months were included in our analysis to represent the organization and use of health services. In the CCHS, this was reported as a continuous variable and medical doctor encompassed family physicians, general practitioners, or specialists such as a surgeon, allergist, orthopaedist, urologist,

gynaecologist, or psychiatrist. In our analysis, we dichotomized this into a binary variable of no consultations or ≥ 1 consultation for ease of interpretation and to assess whether no consultations with a medical doctor was associated with preventable ED visits.

Sense of Community Belonging.

Sense of community belonging was reported in the CCHS as a categorical variable consisting of the following groups: very strong, somewhat strong, somewhat weak, or very weak. In our analysis, this was treated as a binary variable of strong or weak to assess whether the social support and connectedness that is generated through a strong sense of community belonging is associated with preventable ED visits.

Need Characteristics

Need characteristics describe the individual's perceived and evaluated need for care [5]. Evaluated need are professional, objective measures about an individual's physical status and need for medical care, while perceived need are subjective measures of how individuals view their own health and functional status, and how they experience and respond to symptoms [7].

The following need characteristics were included in our analyses: multimorbidity, self-rated general health, and self-rated mental health. Self-rated general health and self-rated mental health represented perceived need, while multimorbidity represented evaluated need.

Multimorbidity.

Multimorbidity was treated as a binary variable (yes or no) and defined as having two more chronic conditions from a list developed by a PHAC working group [8, 9]. These chronic conditions included: asthma, chronic obstructive pulmonary disease, arthritis, heart disease, stroke, diabetes, cancer, and mental disorder (defined as either a mood disorder or an anxiety disorder). Of note, the PHAC working group included Alzheimer's disease; however, this variable was not available in the PUMF and was excluded from our list of chronic conditions.

Self-rated General Health.

In the CCHS, general health referred to the respondent's physical, mental, and social well-being. Self-rated general health was reported in the CCHS as a categorical variable consisting of the following groups: poor, fair, good, very good, or excellent. These categories were retained in our analysis.

Self-rated Mental Health.

Self-rated mental health was reported in the CCHS as a categorical variable of the following groups: poor, fair, good, very good, or excellent. These categories were retained in our analysis.

Health Behaviours

Health behaviours describe the personal practices performed by an individual which may influence their health and use of health services [7].

The following health behaviours were included in our analyses: binge-drinking, smoking status, and illicit drug use.

Binge-drinking.

Binge-drinking was defined as having 5 (if male) or 4 (if female) or more alcoholic drinks on one occasion within the past 12 months [4, 10]. This was reported in the CCHS as a categorical variable consisting of the following groups: never, less than once a month, once a month, two to three times a month, once a week, or more than once a week. In our analysis, this variable was treated as a binary variable of yes (did binge-drink) or no (did not binge-drink) to assess whether engaging in this health behaviour was associated with preventable ED visits.

Smoking Status.

The smoking status of a respondent was determined based on their current or past smoking habits and reported as a categorical variable consisting of the following groups:

current daily smoker, current occasional smoker, former daily smoker and non-smoker now, former occasional smoker and non-smoker now, experimental smoker (had at least one cigarette) and non-smoker now, or lifetime abstainer (never smoked a whole cigarette). In our analysis, this variable was treated as a binary variable of yes (current smoker) or no (current non-smoker or lifetime abstainer) to assess whether engaging in this health behaviour was associated with preventable ED visits.

Illicit Drug Use.

In the CCHS, respondents were asked whether they had smoked, taken orally, snorted, or sniffed illicit drugs, or used a needle to inject or be injected with any drug not prescribed by a doctor within the past 12 months. This was reported as a binary variable of yes or no.

Survey Design Variables

In addition to the above patient characteristics, we controlled for two variables relating to the survey design.

Mode of the Interview.

The mode of the interview was reported as a binary variable of CAPI or CATI.

Alone during the Interview.

Respondents were asked by the interviewer if they were alone during the interview; this was reported as a binary variable of yes or no.

Statistical Considerations

Missing Data

In the next section, we describe the missing data in our study and the statistical methods used to address this. In our study, missing data arose from survey responses of “don’t know”, “refuse”, or “not stated.” 11.5% of respondents had missing data on at least one

of the variables used in our analysis, with the outcome variable having the highest amount of missing data (2.9%).

Missing Data Pattern and Mechanism.

First, we visually assessed the missing data pattern of our study sample. Since there was no pattern to the missing data structure [11], we determined that the missing data pattern was arbitrary. Next, we determined the missing data mechanism. There are three types of missing data mechanisms: (1) missing completely at random (MCAR), (2) missing at random (MAR), and (3) missing not at random (MNAR) [12]. MCAR occurs when the probability that a value is missing is unrelated to the observed or missing data [12]. MAR is when the probability that a value is missing is conditional on the observed data [12]. MNAR is when the probability that a value is missing is related to the missing data itself [12]. In our study, we assumed that the missing data were MAR since it is highly unlikely that the data are MCAR in large epidemiological studies and there are no definitive methods for determining if the data are MNAR [13].

A common procedure for handling missing data is complete case analysis (CCA), which is also the default option of many statistical software [14]. In CCA, respondents who have missing data on any of the variables are excluded from the analysis; however, the CCA relies on the assumption that the data are MCAR and that the respondents with complete information are representative of the respondents with missing information [14]. Since this was not the case in our study, CCA was not used to handle the missing data since it could result in biased estimates and results [14, 15].

Multiple Imputation by Fully Conditional Specification.

Multiple imputation by fully conditional specification (MI-FCS) is an effective statistical technique for handling missing data that are MAR and of an arbitrary pattern [16]. In multiple imputation (MI) procedures, a number of imputed datasets are generated to fill in the missing data with plausible values that incorporate the variability and uncertainty of the missing values [17]. The imputed datasets (now with complete data) are separately analyzed, and then the estimates obtained from each dataset are pooled together to obtain

the overall final estimates and results [17]. One of the limitations of MI, however, is that it assumes that the data has a joint normal distribution [18]. The MI-FCS procedure is a flexible alternative to this as it uses a separate conditional distribution for each type of variable; thus, during the imputation phase, different regression models can be used for each variable's imputation based on the distribution that best fits the variable [11, 16-18]. Logistic regression is used for ordinal categorical variables, discriminant function for nominal categorical variables, regression model with predictive mean matching (PMM) for continuous variables, and binary variables may be imputed using either the discriminant function or logistic regression [11]. PMM uses observed values selected from a specified number of nearest observations to the predicted value from the simulated regression model to fill in the missing values, which ensures that the imputed values are plausible and consistent with the observed values [11]. In our analysis, we set the PMM to five observations.

All correlates and the outcome variable were included in the imputation model; however, the variables were disaggregated to their original categories to improve the efficiency of the MI-FCS process. Since consultations with a medical doctor was originally reported as a continuous variable and multimorbidity was derived from a continuous variable of the number of chronic conditions that respondents had, the continuous variables for these two factors were used.

The variables were imputed as followed:

(1) **Logistic regression (ordinal categorical variables):** Age, education level, immigration status, total household income, sense of community belonging, binge-drinking, smoking status, self-rated general health, and self-rated mental health

(2) **Discriminant function (nominal categorical or binary variables):** Preventable ED visits, sex, marital status, ethnicity, employment status, insurance for prescription medications, illicit drug use, mode of the interview, alone during the interview

(3) **Regression with PMM (continuous variables):** Consultations with a medical doctor and multimorbidity

Based on the recommendation from the literature that the number of imputations should be at least equal to the percentage of incomplete cases [17], we conducted 20 imputations to generate 20 imputed datasets. To evaluate the efficiency of the MI-FCS process, the mean and standard deviation trace plots were visually analyzed. As well, frequency tables were produced for each imputation to ensure that the imputed values were plausible and within the minimum and maximum value for each variable.

Sampling Weights

The CCHS assigns a sampling weight to each respondent, which corresponds to the number of persons in the entire population that are represented by that respondent [2, 3]. The strategy used to create these sampling weights are conducted independently for the list frame (youth population) and area frame (adult population) to create separate person-level weights [2, 3]. During this process, various factors are adjusted for such as the initial LFS or CCTB weight, removing out-of-scope units (dwellings that are demolished, under construction, vacant, seasonal, or secondary), household non-response, and person-level non-response [3]. The person-level weights are then combined into a single set and undergo further adjustment based on geography, age, and sex to create the final sampling weights [2, 3].

In our analysis, the sampling weights were rescaled to reflect the size of our sample after applying the population exclusions. In order for the results of the analysis to be representative of the Canadian population and not just the sample, the re-scaled sampling weights were applied to the statistical analyses.

Multicollinearity

Multicollinearity occurs when two or more variables in a regression model are highly correlated with each other [19, 20]. This could result in unstable and biased standard errors, p-values, and misleading results [20, 21]. We assessed for multicollinearity in our model by calculating the variance inflation factor (VIF) and tolerance. VIF measures the

inflation in the variances of the parameter estimates due to potential multicollinearity [20]. Tolerance is the reciprocal of the VIF and is the percentage of variance in the parameter estimates that cannot be accounted for by the other variables [19]. As a rule of thumb, variables with a VIF ≥ 5 and a tolerance ≤ 0.2 indicates multicollinearity among the variables [19].

In our multicollinearity diagnostic analysis, the highest VIF was 1.646 and the lowest tolerance was 0.607 (Appendix H), indicating an absence of multicollinearity among the variables in our model.

Statistical Analysis

We first obtained the unweighted univariate statistics to describe the patient characteristics of our study sample. To meet the first objective of our study, we then applied the sampling weights to determine the proportion of ED visits that were self-reported to be preventable among adults in Canada who had at least one ED visit in the past year and a regular HCP. To meet our second objective, we obtained the weighted bivariate descriptive statistics to describe the patient characteristics of those who reported having a preventable or non-preventable ED visit. For our third objective, we conducted a series of univariable and multivariable logistic regression analyses to assess the unadjusted and adjusted associations between the patient characteristics and preventable ED visits and to identify the key correlates of these visits.

Logistic regression is a statistical technique that uses a logistic function to model the linear association between the log odds of a binary outcome variable and categorical or continuous predictors, while controlling for other covariates in the model [22, 23]. For our univariable logistic regression analyses (unadjusted models), we assessed the unadjusted associations between each patient characteristic and the outcome variable and only controlled for the two survey design variables. This was expressed as:

$$\log \frac{P(X_1, X_2, X_3)}{1 - P(X_1, X_2, X_3)} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3$$

Where:

X_1 is the predictor variable (the patient characteristic of interest)

X_2 is the survey design variable (mode of the interview)

X_3 is the survey design variable (alone during the interview)

β_0 is the intercept coefficient

β_1 is the regression coefficient associated with predictor X_1 (the patient characteristic of interest)

β_2 is the regression coefficient associated with predictor X_2 (survey design variable – mode of the interview)

β_3 is the regression coefficient associated with predictor X_3 (survey design variable – alone during the interview)

$P(X)$ is the outcome probability for an individual associated with a particular value of X

For our multivariable logistic regression analysis (adjusted model), all patient characteristics and the survey design variables were simultaneously entered to assess the adjusted association between the patient characteristics and the outcome variable. This was expressed as:

$$\log \frac{P(X_1, X_2 \ldots, X_p)}{1 - P(X_1, X_2 \ldots, X_p)} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_p X_p$$

Where:

X_p are the predictor variables

β_0 is the intercept coefficient

β_p is the regression coefficient associated with predictor X_p

$P(X_p)$ is the outcome probability for an individual associated with a particular value of X_p

To determine the odds of the outcome variable, the β-coefficients are exponentiated and expressed as odds ratios [22, 23]. This is interpreted as the change in odds of the outcome for the predictor, relative to the predictor's reference group, and holding all other variables in the model constant [22-24].

Lastly, a sensitivity analysis for the unadjusted and adjusted models was conducted by using the non-imputed data and CCA, in which respondents who had missing responses on at least one variable were excluded from the analysis.

For the univariate and bivariate descriptive statistics, we reported the frequencies and percentages. The unadjusted odds ratio (UOR) for the univariable logistic regression analyses and the adjusted odds ratio (AOR) for the multivariable logistic regression analyses were reported, along with the corresponding 95% confidence intervals (CI) and p-values. Statistical significance was determined at the level of $p < 0.05$.

Statistical Software

All statistical analyses were completed using SAS 9.4 (SAS Institute Inc., Cary, NC, USA). We assessed for multicollinearity using PROC REG with the VIF and TOL options. The descriptive statistics were determined using PROC FREQ. The MI-FCS was conducted using PROC MI, and the logistic regressions were conducted using PROC MIANALYZE with the LOGIT link option to pool the parameter estimates from the imputed datasets. For the sensitivity analysis, PROC LOGISTIC was conducted with the non-imputed dataset, as CCA is the default option on SAS.

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Appendix F: STROBE Checklist for Cross-sectional Studies

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	76
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	76
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	77-78
Objectives	3	State specific objectives, including any prespecified hypotheses	78
Methods			
Study design	4	Present key elements of study design early in the paper	78-79
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	79
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	80
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	80-83
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	80-83
Bias	9	Describe any efforts to address potential sources of bias	-
Study size	10	Explain how the study size was arrived at	80
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	80-83
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	84
		(*b*) Describe any methods used to examine subgroups and interactions	-

		(*c*) Explain how missing data were addressed	83
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	84
		(*e*) Describe any sensitivity analyses	84
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	85
		(b) Give reasons for non-participation at each stage	85
		(c) Consider use of a flow diagram	86
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	87-89; 90-92
		(b) Indicate number of participants with missing data for each variable of interest	88-89
Outcome data	15*	Report numbers of outcome events or summary measures	90
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	93-97
		(*b*) Report category boundaries when continuous variables were categorized	-
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	98-100
Discussion			
Key results	18	Summarise key results with reference to study objectives	101
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	105-106
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	101-105

Generalisability	21	Discuss the generalisability (external validity) of the study results	106-107
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	108

*Give information separately for exposed and unexposed groups.

From: von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP, et al. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. BMJ. 2007;335(7624):806-8. doi: 10.1136/bmj.39335.541782.AD. PubMed PMID: 17947786; PubMed Central PMCID: PMC2034723.

Appendix G: List of Canadian Community Health Survey (CCHS) Variables Included in the Analysis

Construct	Measure	CCHS variable(s)	Survey question / source	Type of variable	Categories used in analysis
Survey Design Variables					
	Mode of the interview	ADM_040	Was this interview conducted on the telephone or in person?	Binary	0 = Computer-assisted telephone interviews 1 = Computer-assisted personal interviews
	Alone during the interview	ADM_045	Was the respondent alone when asked the health component of this questionnaire?	Binary	0 = Alone during the interview 1 = Not alone during the interview
Outcome					
	Preventable emergency department visit	CHP_020	The last time you went to the emergency room, was it for a condition that you thought could have been treated by your primary care provider if he/she had been available?	Binary	0 = No (Non-preventable emergency department visit) 1 = Yes (Preventable emergency department visit)
Pre-disposing Characteristics					
Demographic and social factors	Age	Derived variable from grouping respondent's age	Completed by interviewer based on respondent's date of birth and date of interview. If necessary, asked, "What is your age?"	Ordinal	1 = 18-44 2 = 45-64 3 = 65 or older

Sex	DHH_SEX	Completed by interviewer. If necessary, asked, “Is respondent male or female?”	Binary	0 = Female 1 = Male
Education level	EHG2DVR3	Derived variable from questions asking the highest level of education attained by the respondent	Binary	0 = Less than secondary school 1 = Secondary school and beyond
Employment status	LBFDVWSS & LBFDVPFT	Derived variable from questions asking about respondent’s working status and whether they had worked in the week prior to their interview	Binary	0 = Unemployed 1 = Employed (part-time or full-time)
Marital status	DHHGMS	Derived variable from grouping respondent’s marital status	Binary	0 = Widowed/divorced /separated/single 1 = Married/common-law
Ethnicity	SDCDGCGT	Derived variable from questions asking about the cultural or racial background of the respondent	Binary	0 = White 1 = Non-white
Immigration status	SDCDVIMM & SDCDGRES	Derived variable from questions asking whether the respondent was an immigrant and length of time since becoming a landed immigrant	Ordinal	0 = Canadian-born 1 = Non-permanent resident or recent landed immigrant (0 to 9 years) 2 = Established landed immigrant (≥ 10 years)

Enabling Characteristics

Financial resources	Total household income	INCDGHH	Derived variable from grouping respondents' total household income	Ordinal	1 = No income or less than $39,999 2 = $40,000 to $79,999 3 = $80,000 or more
	Insurance for prescription medications	INS_005	Do you have insurance that covers all or part of the cost of your prescription medications?	Binary	0 = No 1 = Yes
Use of health services	Consultations with a medical doctor	CHPDGMDC	Derived variable from grouping responses to questions: "Not counting when you were an overnight patient, in the past 12 months, have you seen or talked to a family doctor or general practitioner about your physical, emotional or mental health?" and "Not counting when you were an overnight patient, in the past 12 months, have you seen or talked to any other medical doctor or specialist such as a surgeon, allergist, orthopaedist, [males: urologist/females: gynaecologist] or psychiatrist about your physical, emotional or mental health?"	Binary	0 = No consultations 1 = One or more consultations

Social Support	Sense of community belonging	GEN_030	How would you describe your sense of belonging to your local community? Would you say it is: very strong, somewhat strong, somewhat weak, or very weak?	Binary	0 = Weak 1 = Strong
Need Characteristics					
Evaluated Need	Multimorbidity	CCC_015, CCC_030, CCC_050, CCC_085, CCC_090, CCC_095, CCC_130, CCC_195, CCC_200	Created from variables asking if the respondent has: asthma, chronic obstructive pulmonary disease, arthritis, heart disease, stroke, diabetes, cancer, mood disorders, and anxiety disorders	Binary	0 = No (≤ 1 chronic condition) 1 = Yes (≥ 2 chronic conditions)
Perceived Need	Self-rated general health	GEN_005	In general, would you say your health is: excellent, very good, good, fair, or poor?	Ordinal	1 = Poor 2 = Fair 3 = Good 4 = Very good 5 = Excellent
	Self-rated mental health	GEN_015	In general, would you say your mental health is: excellent, very good, good, fair, or poor?	Ordinal	1 = Poor 2 = Fair 3 = Good 4 = Very good 5 = Excellent
Health Behaviours					

Personal health practices	Binge-drinking	ALC_020	How often in the past 12 months have you had [males: 5/ females: 4] or more drinks on one occasion?	Binary	0 = No (did not binge-drink) 1 = Yes (did binge-drink)
	Smoking status	SMKDVSTY	Derived variable from questions asking about respondent's smoking habits	Binary	0 = No 1 = Yes
	Illicit drug use	DRMDVLAY	Derived variable from questions asking about respondent's illicit drug use over the past 12 months	Binary	0 = No 1 = Yes

Appendix H: Multicollinearity Diagnostics

Independent Variable	Variance Inflation Factor	Tolerance
Age	1.646	0.607
Sex	1.053	0.950
Education level	1.130	0.885
Employment status	1.459	0.685
Marital status	1.155	0.866
Ethnicity	1.348	0.742
Immigration status	1.354	0.738
Total household income	1.382	0.724
Insurance for prescription medications	1.054	0.949
Consultations with a medical doctor	1.050	0.953
Sense of community belonging	1.054	0.949
Multimorbidity	1.291	0.775
Self-rated general health	1.552	0.644
Self-rated mental health	1.365	0.733
Binge-drinking	1.292	0.774
Smoking status	1.144	0.874
Illicit drug use	1.188	0.842

Outcome variable: Preventable emergency department visits

Curriculum Vitae

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Conference Presentations:

Oral Presentation
Lau, T., Ali, S., & Wilk, P.
Preventable Emergency Department Visits in Canada – An Analysis of the 2015-2016 Canadian Community Health Survey
2020 Canadian Association for Health Services and Policy Research Conference*
Saskatoon, Saskatchewan, Canada; May 26, 2020

Oral Presentation
Lau, T., Sriskandarajah, C., Wilk, P., & Ali, S.
The Prevalence and Patient Characteristics Associated with Preventable Emergency Department Visits in Canada – A Systematic Review
2020 Canadian Association for Health Services and Policy Research Conference*
Saskatoon, Saskatchewan, Canada; May 26, 2020

Keynote Oral Presentation
Lau, T., Ali, S., & Wilk, P.
Preventable Emergency Department Visits in Canada – An Analysis of the 2015-2016 Canadian Community Health Survey
Western Research Forum 2020*
London, Ontario, Canada; March 19, 2020

Poster Presentation
Lau, T., Sriskandarajah, C., Wilk, P., & Ali, S.
The Prevalence and Patient Characteristics Associated with Preventable Emergency Department Visits in Canada – A Systematic Review
Western Research Forum 2020*
London, Ontario, Canada; March 19, 2020

*Abstract accepted; in-person conference cancelled due to COVID-19