

**The Last Call: Physicians Who Deliver House Calls At the End of Life  
A Retrospective Cohort Study of Primary Care Physicians and Their Home Care  
Practices in Ontario, Canada**

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Thesis submitted to the University of Ottawa  
in partial Fulfillment of the requirements for the  
Masters of Science

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## Preface

This document is a Master's thesis conducted by the student, Mary Scott, and was based on the proposal approved by the Department of Medicine's School of Epidemiology and Public Health at the University of Ottawa for completion in 2021. Mary Scott was responsible for conducting a literature review, obtaining ICES student status, writing the proposal, specifying the details of the data cut for an ICES analyst, performing the analysis using SAS software, interpreting the results, and writing the results into a manuscript-based thesis. Mary's supervisors, Drs Tanuseputro and Manuel, and Thesis Advisory Committee (TAC) provided feedback throughout the Master's degree timeline including to the proposal, the proposed analysis plan, preliminary results, and the thesis manuscript.

This project has been approved by the Research Ethics Board at The Ottawa Hospital Research Institute (CRRF ID: 1925) and has been submitted to the privacy office at ICES uOttawa and ICES central sites with an approved ICES TRIM of 2020 0901 241 000.

## Abstract

**Introduction:** Home visits have become increasingly uncommon although evidence suggests they improve healthcare quality and reduce overall expenditures. This thesis identifies the number and proportion of physician delivering home visits at patient's end of life and describes characteristics of primary care physicians delivering end-of-life home visits and explores associations with delivery.

**Method:** A retrospective cohort design using population-level health administrative data housed at ICES.

**Results:** A total of 9,884 physicians were identified, of which 2,568 (25.7%) delivered at least one end-of-life home visit. Variables associated with increased odds of home visit delivery were older age, international training, capitation models of remuneration, and population size.

**Conclusions:** This research demonstrates primary care physician's characteristics and home visit practice patterns. This study aims to improve end-of-life primary care at a system and provider level by identifying factors associated with increased service provision. Increasing physician home services could greatly improve the dying experience of Canadians.

Abstract word limit: <150 words

Abstract count: 149

## Acknowledgements

There are many people and resources that have helped me complete this thesis work. I am very grateful for each and every one.

My thesis supervisor, **Dr. Peter Tanuseputro**, was instrumental in my transition into medical research from anthropology. His mentorship and endorsements enabled my entry into this program as the only student with an arts degree. I literally could not have achieved this without his guidance and belief in my abilities. **Dr. Douglas Manuel**, my co-supervisor, has also continued to support my journey ever since I began as an undergraduate student as a source of wisdom, encouragement, and a passionate life-long learner. He always provides ways to broaden my skills and improve research processes. **Dr. Amy Hsu** has been an inspiration since I met her during her post-graduate fellowship at the Ottawa Hospital Research Institute. Her drive, professionalism, and passion for research are so apparent and her exemplary qualities ignite a stronger desire within me to work harder on research that results in positive change. **Dr. Sarina Isenberg** is someone who possesses incredible focus and organizational skills, while simultaneously incorporating creativity and vision in her work. Working with her pushes me to be a better researcher in both practice and mindset. I am so grateful for her encouragement and mentorship. **Dr. Tim Ramsay** was the first professor to teach me biostatistics and I couldn't have asked for a better introduction. His practical and honest approach to solving healthcare problems through data created a good foundation that also engaged my intellectual curiosity, making biostatistics a topic I enjoy to research and practice. I am also honoured with his support and his time spent providing feedback. **Dr. Colleen Webber**, a mentor to me ever since I met her, is incredibly intelligent, efficient, and level-headed all while remaining humble. I am very grateful for her guidance and help with my work and decisions. A heartfelt thank you to **Sue Hierlihy** for her copy edits – I appreciate you taking time away from your vacation for this piece of work.

While my academic support was arguably world-class, I was also personally supported by a network of friends and family that are truly invaluable and close to my heart. **Kerin Hudson**, your daily encouragement and listening ear will always be remembered and appreciated. Whether it was sitting with me while I went through possible coding failures or providing feedback on my writing, you got me through this in so many ways. I cannot imagine where I (or this thesis) would be without you and our friendship. **Zuzanna Keough**, although across the country, you continually made me feel loved and kept me laughing throughout these past two years. You are a gem. **Hira Khan** and **Zaina Kahiel** – you two are beautiful people and your friendship has made this Master's degree not only memorable, but also a wonderful experience. I have been encouraged and gifted with the friendship of **Elissa Cucan** during this time, whose support towards my future career aspiration in medicine is invaluable and came at a really important time for me. My partner, **Will Clarke**, came into my life during this degree and I am so grateful for our relationship. Your love, encouragement, and cooking has brought me from surviving to thriving. The challenges of this degree were less difficult with the excitement and energy you brought to my life.

My family have been a real source of growth and have shaped me into the person I am today. Thanks for the constant love I receive from my siblings and their partners. My parents have been the ultimate source of love and grounding advice throughout my life and these past two years were no exception. My mom, **Josie Scott**, has been a listening ear, a supportive shoulder and a source of wisdom that cannot be rivalled. My dad, **John Scott**, often listened to my difficulties and was a continuous source of sage advice and updates from the medical community. My work in medical research has been largely influenced and continuously inspired by his own career.

# Table of Contents

PREFACE.....	II
ABSTRACT.....	III
ACKNOWLEDGEMENTS .....	IV
LIST OF TABLES.....	VII
LIST OF FIGURES .....	VIII
LIST OF ABBREVIATIONS .....	IX
<b>CHAPTER 1: INTRODUCTION .....</b>	<b>1</b>
1.1 Background and Rationale.....	1
1.2 Thesis objectives.....	3
1.3 Hypotheses (defined a priori in proposal) .....	3
1.4 Study Design Overview.....	4
1.5 Thesis Outline.....	5
<b>CHAPTER 2: LITERATURE REVIEW.....</b>	<b>5</b>
End-of-life care.....	5
Disease trajectories.....	7
End-of-life home visits.....	7
Primary care at the end-of-life.....	8
Cost-effectiveness of home visits .....	10
Remuneration models.....	11
System development.....	11
Physician characteristics .....	12
Literature gap .....	12
<b>CHAPTER 3: METHODS.....</b>	<b>14</b>
3.1 Study Population .....	14
3.2 Study Timeframe .....	14
3.3 Data sources .....	15
3.4 Study variables and covariates .....	19
3.5 Exploratory analysis .....	25
3.6 Statistical analysis.....	25
<b>CHAPTER 4: WHICH PRIMARY CARE PHYSICIANS DELIVER HOME VISITS TO THEIR DYING PATIENTS IN ONTARIO? A RETROSPECTIVE COHORT STUDY DESCRIBING PHYSICIAN CHARACTERISTICS ASSOCIATED WITH DELIVERING HOME VISITS TO PATIENTS IN THE LAST YEAR OF LIFE. ....</b>	<b>26</b>
4.1 Introduction.....	26
4.2 Methods .....	27
4.3 Results.....	31
4.4 Discussion.....	45
<b>CHAPTER 5: ADDITIONAL RESULTS.....</b>	<b>49</b>
<b>CHAPTER 6: DISCUSSION.....</b>	<b>56</b>

Overview .....	56
Home visits and care quality indicators .....	56
Comparing results to previous literature .....	56
Novel physician variables.....	58
Remuneration .....	59
Strengths and Limitations .....	61
Conclusion .....	62
<b>REFERENCES.....</b>	<b>64</b>
<b>APPENDICES.....</b>	<b>72</b>
<i>Appendix I: OHIP billing codes used to determine a home visit delivery (according to the OHIP schedule of benefits 2020).....</i>	<i>72</i>
<i>Appendix II: Crude rate calculation of the rate of home visits delivered by physicians within Ontario based on number of physicians and decedents in the region during the study period. ....</i>	<i>73</i>
<i>Appendix III: ICES Databases description and the associated study variables .....</i>	<i>74</i>

## List of tables

Table 1: Description of final cohort.....	p. 40
Table 2: Physician characteristics according to the primary outcome (home visits.....	p. 42
Table 3: Physician characteristics according to their practice remuneration model .....	p. 47
Table 4: Crude rates of home visits delivered by primary care physician to patient in their last year of life across Ontario according to the number of decedents who died in each local health integration network (LHIN) between 2016-2019.....	p. 49
Table 5: Regression analysis modelling the odds of a physician delivering a home visit to a patient in their last year of life between 2016-2019 in Ontario .....	p. 49
Table 6: Regression analysis modelling the odds of a physician delivering a home visit to a patient in their last year of life between 2016-2019 in Ontario.....	p. 52

## List of figures

Figure 1: Thesis objectives.....	p. 11
Figure 2: Cohort creation.....	p. 22
Figure 3: Flow sheet of the data merge.....	p. 23
Figure 4: Logic map of visit definition.....	p. 27
Figure 5: Crude rate of home visits delivered by physicians within Ontario based on the number of physicians and decedents per LHIN during the study period.....	p. 46
Figure 6: Distribution of primary care physicians' age according to home visit delivery for patients at the end of life between 2016-2-19 in Ontario.....	p. 52
Figure 7: Distribution of Wilcoxon score for age based on home visit delivery.....	p. 54
Figure 8: Distribution of primary care physicians' age by sex according to home visit delivery for patients at the end of life between 2016-2-19 in Ontario.....	p.55
Figure 9: Distribution of physician's years since graduation according to end of life home visit delivery during fiscal years 2016-2019 in Ontario Canada.....	p. 56
Figure 10: Distribution of Wilcoxon score for years of physician practice by home visit delivery.....	p. 57
Figure 11: Distribution of physician's travel distance between their home and office according to end-of-life home visit delivery during fiscal years 2016-2019 in Ontario, Canada.....	p. 58

## List of abbreviations

CAPE: Client Agency Program Enrollment

CPDB: Corporate Provider Database

DAD: Discharge Abstract Database

IPDB: ICES Provider Database

LTC: Long term care

NACRS: National Ambulatory Care Reporting System

OHIP: Ontario Health Insurance Plan

PC: Palliative care

RPDB: Registered Persons Database

IKN: ICES Key Number (De-identified Unique Identification)

MOMBABY: ICES derived dataset capturing the characteristics of deliveries, newborns and mothers in Ontario

## Chapter 1: Introduction

### 1.1 Background and Rationale

#### *Overview of problem*

The need to prioritize palliative and end-of-life care in the community and home setting is recognized internationally. As patients approach the end of life, visiting their physician's office can be unmanageable and many prefer to receive care at home.(1-6). Acute care may be appropriate for some dying patients, yet it was designed for time-sensitive management with a curative intent, not as an alternative to primary care that is primarily focused on quality of life.(7) Primary care physicians have been poised as the champions of community-based end of life care.(8) Community-based home visits by physicians are associated with improved patient outcomes including higher self-reported quality of life, lower acute care use, and more deaths in patient's preferred location.(9-18) However, physicians visiting dying patients in their home have become increasingly uncommon,(19-21) and the majority (59.5%) of Canadians are dying in hospital.(22) A recent study comparing Canada to 6 other developed countries showed that Canada had the highest rate of hospital deaths (e.g., United States had 29% of decedents dying in hospital) and spent the most on caring for patients in their last 6 months of life.(23) A recent study in Ontario found only 1 in 5 patients received a home visit from a physician in their last year of life.(16) With mounting evidence that home visits are beneficial to patients and with the anticipated surge in acute healthcare use arising from an aging population,(24, 25) efforts to support the provision of home visits are paramount.

#### *Introduction to literature gap*

As home visits remain an optional service for primary care physicians in many jurisdictions, including the place of the current study—Ontario, Canada--understanding physicians' perspectives on providing this service is vital. Existing literature suggests physicians may not be delivering home visits

due to demands on time, administrative load, lack of financial incentives and challenges navigating the home environment.(26-29) Evidence suggests characteristics of physicians delivering home visits are more likely male, older, being specialized in primary care, geriatrics, or osteopathy, having a solo practice, living in a rural area, and experience practicing in community settings.(19-21, 30, 31) This is the first study capturing health characteristics of the physicians *themselves* including their previous hospitalizations, emergency department visits, and childbirths. Previous evidence was all based on data from the United States and many studies were published over a decade ago. Two studies used administrative data (20, 21) with the others using survey-based methods,(31, 32) which are prone to self-report bias and selection bias. These studies are also not specific to end-of-life populations which may influence physician characteristics and their rationale for visiting patients. End-of-life visits are palliative in nature, thus more beneficial when physicians possess experience and expertise in delivering end-of-life care to facilitate home deaths. This includes physicians' own comfort with having end-of-life discussions, in providing medications for symptom relief including subcutaneous formulations, and ability to provide on-call coverage. These visits, for example, differ from home visit services that provide mainly 'convenience' services for a variety of reasons such as viral infections and chronic disease management.

Building evidence of physicians' own health and system-level factors associated with home visits during the end of life is important, especially in the context of an aging population.(25) This research uses novel characteristics to explore differences in primary care physicians who deliver end-of-life home visits compared to those who do not, and establishes associations between physician characteristics and the delivery of home visits in Ontario, Canada during fiscal years 2016-2019.

## 1.2 Thesis objectives

### *Primary objective*

Describe primary care physicians' demographic, practice, and health characteristics (e.g., age, sex, medical training, years in medical practice, remuneration model, recent visit to the emergency department, etc.) comparing those who provided end of life home visits to who did not provide end-of-life home visits in Ontario between 2016-2019 (Figure 1).

### *Secondary objective*

Identify physician characteristics that are associated with home visit delivery and explore geographic variations across Ontario during study period.

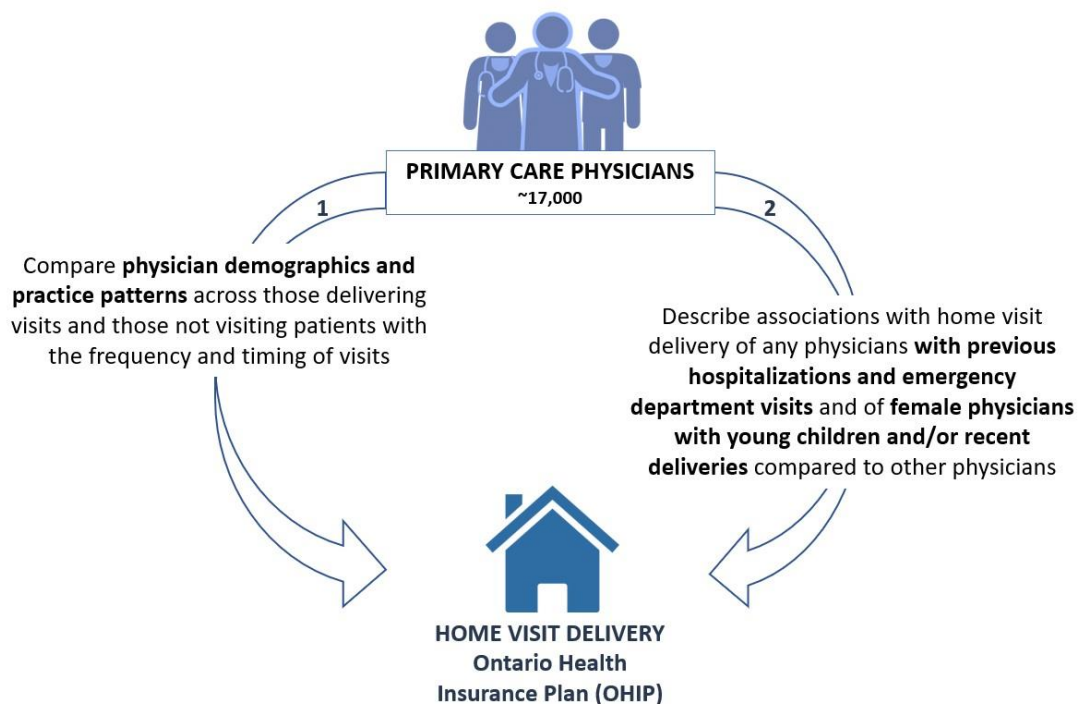


Figure 1: Study objectives describing and comparing physician characteristics associated with home visit delivery in Ontario between years 2016-2019.

## 1.3 Hypotheses (defined *a priori* in proposal)

**Hypothesis 1:** physicians with more experience in home care, older physicians (who trained when home visits were more common) and physicians near the end of their career (with more comfort and

interest in pivoting towards end-of-life and palliative care) will deliver more home visits, thus characteristics such as age and years in practice will influence the rate of home visits.

**Hypothesis 2:** The majority of primary care physicians do not provide home visits for patients at end of life. Out of those delivering visits, a higher proportion of physicians are delivering home visits as their main practice rather than delivering occasional home visits alongside their office practice.

**Hypothesis 3:** Home visits are delivered at different rates across the province of Ontario and rural areas have a higher rate of physician home visits.

**Hypothesis 4:** Physicians with health events (i.e., recent hospitalizations, emergency department visits, and childbirth) will have reduced odds of delivering home visits due to having less time and needing more focus on their own health. Young parents and sick physicians may have more barriers to delivering palliative care because of the perception of needing to be on call and the time commitment of making home visits.

#### 1.4 Study Design Overview

I conducted a retrospective cohort study using population-level data to describe the delivery of end-of-life home visits by primary care physicians in Ontario and determine characteristics of physicians delivering end-of-life home visits. Physician home visits were captured using physician billings in the Ontario Health Insurance Plan Claims Database (OHIP) and linked to the College of Physicians and Surgeons of Ontario (CPSO) database to identify primary care physicians in Ontario newly registered between fiscal years 1990-2016. Differences between physicians who delivered home visits and those who did not visit patients at home were characterized according to their demographics obtained from Registered Persons Database files (RPDB) and the ICES Physician Database (IPDB), system level remuneration models was pulled from the Client Agency Program Enrolment Data (CAPE), regional variation was calculated using Statistics Canada's Postal Code Conversion File Plus (PCCF+) macro, visit

type (i.e. palliative care, assessment for homebound patient, etc.) was determined using OHIP, and physician's own health history was determined by linking their CPSO profile to ICES databases – allowing us to examine physician as patients, including pulling hospitalization records held at the Discharge Abstract Database (DAD) and emergency room visits using the National Ambulatory Care Reporting System (NACRS).

## 1.5 Thesis Outline

This thesis is manuscript-based and is organized into six chapters. Chapter 2 is a literature review covering the current literature on differences between end-of-life care in primary and acute care settings, primary care models, delivery of home visits, predictors of receiving a home visit, barriers to home visit delivery, and remuneration models. Chapter 3 describes the methods in detail including all data sources, cohort creation, study outcomes, study variables, and statistical analysis. Chapter 4 is a descriptive manuscript of the study objectives describing differences between physicians delivering visits and those not delivering visits, as well as showing geographic variation across the province. Chapter 5 contains additional results describing the descriptive analysis and model considerations in more detail. Chapter 6 is the discussion which includes a summary and discussion of study findings, comparisons to previous literature, strengths and limitations, contributions to the literature, local implications, and generalizable study findings.

## Chapter 2: Literature Review

### End-of-life care

Increasing the provision of high-quality end-of-life care has been recognized as an international health priority.(15, 33-35) At the end of life, patient's health status declines and acute care utilization increases.(23, 36-40) Acute care was designed to address complex, potentially reversible, time-sensitive care and not as an alternative to ongoing support from primary care teams, including primary care for

terminally ill patients that can focus on quality over quantity of life.(7) As a patient's disease and frailty progresses, visiting a primary care physician's office may be difficult - even impossible - without support and becomes increasingly burdensome.(41, 42) Patients who experience a sudden decline in health without adequate primary care support often face hospitalization (i.e., visits to the emergency room), receiving treatment that is aggressive, costly, and incongruent with their wishes.

Palliative care, a care approach originating from the United Kingdom (UK) hospice movement,(43) is characterized by an interdisciplinary team that aims to improve the quality of life for patients with life-limiting illnesses and enable a good death.(43-45) Palliative care is not delivered to many patients,(46, 47) and is often initiated late in a patient's disease trajectory.(48) There is research showing early initiation of palliative care can lead to better patient- and system-level outcomes.(49-51) Palliative care is delivered in all settings with a few physician specialists delivering only palliative care, and many physicians delivering palliative care as a portion of their practice.(18) There is a growing understanding that palliative care should be shared – with primary care “generalist” physicians leading the care and palliative care specialist consultants supporting care as needed.(18, 52) Until recently in Canada, palliative care was considered a sub-specialty under a general medical specialty. To capture the number of physicians practicing palliative care using health administrative data, an algorithm was developed and validated.(53) Briefly, this chart-validated definition is 97.8 (95% CI: 92.5–99.7) specific and 76.0% (95% CI: 54.9–90.6) sensitive in capturing self-identified palliative care specialists when using a threshold of greater than 10% of billings as palliative care. Although we know many physicians are delivering palliative care in Ontario, there is a gap in the literature on how many primary care physicians are actively involved in managing care for patients who are actively dying, particularly for those who may be housebound, or who desire to be cared for at home.

## Disease trajectories

At the end of life, three illness trajectories have been outlined in Lynn and Adamson(54) and further developed by Murray et al. to provide a broad understanding of how progressive disease characteristics can considerably shift goals of care and patients' need.(55) The disease trajectory may influence a patient's propensity to receive physician home visits. The *terminal illness* trajectory is characterized by a short period of steady, evident decline, which is often seen in cancer. There is evidence that a higher proportion of those dying with cancer die at home,(16, 56) which may be due to the clinically observable decline experienced by most patients within a much shorter timeframe than other chronic conditions (i.e., a clearly defined terminal phase). The *organ failure* trajectory, characterized by gradual decline, is punctuated with acute episodic intervals and often ending with a seemingly perceived unexpected death are more typical for diseases such as Chronic Obstructive Pulmonary Disease (COPD) and Congestive Heart Failure (CHF). Although these patients are often diagnosed and receive care from specialists, their goals of care may remain ambiguous and disease management may be focused on the episodes of organ failure. The third trajectory is the *frailty* trajectory, marked by prolonged, gradual decline with onsets of functional and cognitive deficits often due to dementia or other age-related diseases. This decline (including the 'terminal' phase) may be difficult to detect and, due to the variability across individuals on this trajectory, the patient's ideal goals of care and disease management can also be unclear. Evidence of patient's disease trajectory impacting care, for example terminally ill patients being more likely to receive palliative care and die at home,(16, 56, 57) suggests there may be a relationship between patient's disease characteristics and a physician's practice patterns as they care for patients at the end of life.

## End-of-life home visits

Evidence suggests home visits during the end-of-life period are uncommon.(16, 19, 20, 27, 58) Home visits at the end of life have been shown to increase likelihood of dying at home, increase satisfaction with care, and reduce acute care utilization.(12, 13, 59, 60) Access to physician home visits could reduce

hospitalizations, improve the population cost of preferential care, and enable a ‘good death’ experience for Canada’s aging population.(25, 44) In the United States (US), it has been reported that only 1% of Medicare beneficiaries received a visit and only 1 in 5 patients received a home visit during their last year of life in Ontario.(16, 20) An ecological analysis of physician visits over time in Ontario also found no home visits were delivered for 30.9% of physician years in the analysis,(60) suggesting a significant proportion of time is not allocated to home-based services. Historically, visiting the home was a significant part of a physician’s practice and accounted for 40% of patient-physician encounters before the 1970’s.(61)

Comparing home visit rates over time and across countries is challenging, as key terms (such as ‘hospice’) and healthcare organization differ across time and space.(62) In the United Kingdom (UK) – one of the countries well known to deliver comprehensive end-of-life care in the community – end-of-life home visits are still a regular part of primary care practice and primary care is organized to include additional palliative supports. Palliative care nurses and physician specialists in the UK are integrated into the primary care system as consultants to support increased care demands on primary care physicians at the patient’s end of life. This ensures access to non-acute healthcare resources is available and enables patients to remain at home.(63) Although there was a decline in home visits from the mid-20<sup>th</sup> century, as many countries face an aging population, there has been a resurgence in home visits.(24, 64) Understanding primary care organization is a key factor in understanding how primary care physicians may be better integrated into community end-of-life management.

#### Primary care at the end-of-life

Primary care has been described according to four features: first contact for patients; long-term patient-focused care; comprehensive care for most healthcare needs; and coordination of care needs in other settings.(65) Quality of primary care can be assessed based on the fulfillment of these four features. A coordinated healthcare system requires a strong primary care system.(66) The variety of international healthcare systems demonstrate that primary care arrangement influences care coordination across other

settings. Primary care in the UK, for example, provides comprehensive care to patients, integrates practitioners in decision-making, and monitors performance at a local and national level. In juxtaposition, the Canadian primary care system has been described as adjacent to the rest of the system, without the same monitoring and integration as the UK or other well-coordinated systems.(67)

The Beveridge model and the Bismarck “mixed” model have been categorized as the two main models of healthcare according to funding.(68, 69) The Beveridge model is publicly funded and the Bismarck is a mix of public and privately funded healthcare.(68) Canada is often described as having universal healthcare, however, aligns with the Bismark model since there are privately funded services, including some end-of-life community supports. Understanding characteristics and resources available within each locality is a first step in developing supports to facilitate more home visits and relieve the acute care system. Although each locality organizes healthcare according to funding and policy, physicians often have flexibility in patient enrollment and are given the choice of how they organize many aspects of their practice. Networks across different physicians and their patients have been identified in the US and Ontario.(70, 71) Building upon this work, understanding the composition of end-of-life resources and palliative care supports within communities could help understand how to assess primary care system quality while accounting for inequality of resources.

Primary care physicians, who are often part of a patient’s care for extended periods of time and may identify the early onset of a disease, have been poised as the ideal providers to manage end of life care in the community.(8) In fact, a recent study conducted in British Columbia, Canada found the majority of primary care physicians felt home visits were the most important aspect of end-of-life care, yet identified multiple barriers to including visits in their practice.(72) Similarly, a national survey done in the United States found of majority of primary care physicians reported home visits as being an important aspect of primary care.(32) More information about the current difference in regional resources and the reorganization of patient and provider supports would be required in many jurisdictions to enable primary

care to manage end-of-life care.(73) There are alternate models of healthcare that include more end-of-life supports. For example, in the UK home visits are delivered routinely by a physician or nurse practitioner.(63) However, there are a number of differences in how healthcare and government is structured in Canada and a paucity of evidence on the effectiveness of implementing these models into an established healthcare system.(74) It has also been suggested that the UK has a cultural acceptance of government initiatives that differs from the attitudes of Canadian physicians.(67) Smith et al. suggested the local context determines an ideal healthcare model more effectively than fitting one standard model to different localities.(75) Reforming a healthcare system is a slow process and can have unintended consequences, particularly when previous policies are overlooked.(66) This adds to the remaining gap in the literature as to how primary care physicians are involved in managing care for patients who are actively dying who may be housebound or who desire to be at home.

#### Cost-effectiveness of home visits

Home visits by physicians are associated with high healthcare quality and may lower overall expenditures.(76) Evidence that physician home visits reduce acute care utilization,(12, 13, 59, 60, 77-80) may indicate these visits can mitigate care costs and enable a preferential place of death. However, evidence on the cost-savings achieved with home visits is inconclusive.(81, 82) This is due to a number of factors including that home visit services vary from individual physicians delivering select patients home visits to an experienced palliative care team providing patients “hospital-at-home” through a regionally funded service.(80, 82) One study conducted in Japan shows initiating home visits earlier for a long-term intervention is associated with cost saving, while shorter-term care plans are associated with higher costs.(79) These results are congruent with Ontario-based studies showing early initiation of palliative care is associated with reduced acute care use and when palliative care is introduced late in a patient’s disease trajectory, often higher costs are procured.(50) The issue of cost-effective care could be related to early-stage disease management and should be explored accounting for time variations. Cost-

effectiveness may also be related to how physicians approach care and organize their own practice remuneration.

### Remuneration models

Existing literature found that the main reasons physicians do not deliver home visits are demands on time, administrative load, lack of financial incentives, and challenges navigating the home environment.(26-29) In 2011, the Health Minister of Ontario announced a plan to spend \$60 million annually to provide financial incentives for physicians to visit people at home, with funding incentives for an increased number of visits to the same patient.(83) The plan was meant to help coordinate all aspects of patient's care through an integrated team of healthcare providers. There were annual increases in home visits from 2011-2015(84) for an overall total of 100,000 more visits per year (annual increases between 2.9%-12.6%), which suggests that this funding was effective. However, the increase in home visits may have not been directly helping patients whose conditions could worsen and require acute care. The 2011 plan incentivised services in Ontario to offer home visits from physicians for patients with any medical need who did not wish to leave their home.(85-87) These changes resulted in physicians receiving substantially higher compensation for their home visit (between \$109.05 and \$191.55) than if it were in the office (between \$21.70 and \$77.90). The annual budget was modified in 2019, and restrictions placed on who could receive such a home visit to only include frail and elderly or housebound patients who were unable to visit a physician's office.(88, 89)

### System development

Primary healthcare models in other countries and jurisdictions have noted increased pressure on the existing workforce.(74, 90) Physicians are expected to manage a growing number of patients and act as gatekeepers to the acute care system. Primary care physicians may feel burdened if they are expected to deliver care in the home. There are a number of suggestions to reorganize the primary health care model

with primary care physicians poised as crucial to effective care delivery at home,(73) yet there is a paucity of evidence on the effectiveness of these models.(74) Furthermore, if local context determines the ideal healthcare model more effectively than fitting one model to different localities,(75) understanding the current context is vital. This supports describing unique physician characteristics within Ontario and developing a strong understanding of what facilitates physicians' delivery of home visits at the end of life, to understand how local supports can be utilized or developed to enable delivery and identify potential barriers to this care.

#### Physician characteristics

Primary care physicians are often part of a patient's care for extended periods of time and many identify the early onset of a disease in their patients. Although primary care physicians have been poised as the ideal providers to manage care in the community,(8) it remains uncertain if and how care varies according to physician's own characteristics. The majority of evidence on factors associated with home visits are based on patient demographics and outcomes,(16, 91-93) with limited research on physician-focused factors, including a lack of information on how the health of physicians themselves impact their propensity to do home visits – something to explore through linkage of physician information from CPSO to the databases held at ICES.(32) Physician characteristics previously found to be associated with delivering home visits are being male, older, being specialized in primary care, geriatrics, or osteopathy, having a solo practice, living in a rural area, and having experience practicing in community settings.(19-21, 30, 94) This study will bring a population-level understanding of Ontario physicians, integrating new physician-based factors not previously inspected in home-visit research.

#### Literature gap

Evidence on physician characteristics was mostly based on data from the United States and many studies were published over a decade ago. Two studies used administrative data (20, 21) with the others using survey-based methods, which are prone to self-report bias. Additionally, this literature is not specific

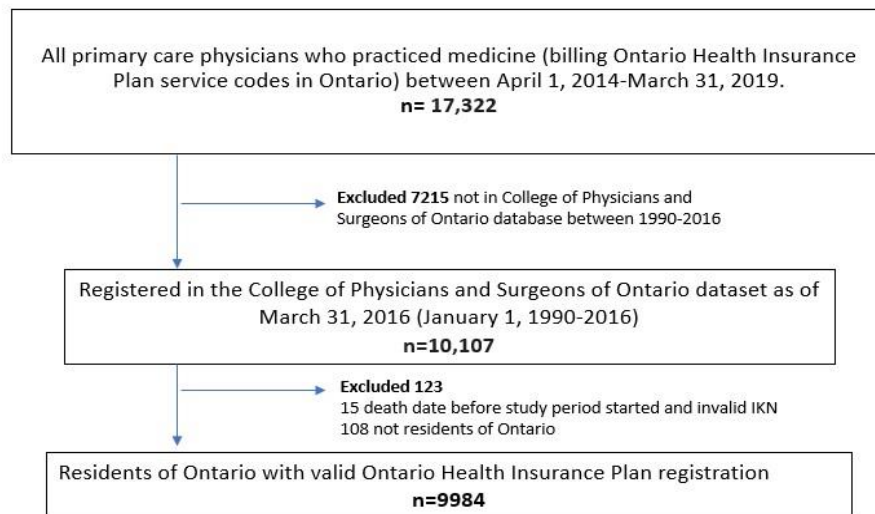
to end-of-life populations and physician characteristics and rationale for visiting dying patients may be vastly different. Increased pressure on the existing primary care workforce has been noted.(74, 90) Projections based on an aging population in Japan show that an increase in physician home visits can be a solution to the anticipated care demands, however this requires health resource allocation and advanced system-level planning.(95). Investigating physician's characteristics within a different context will not only provide stronger evidence of determinants of home visit delivery, and helps in developing supports for physicians that may face barriers to delivering this service. Additionally, there is no evidence on the frequency with which physicians deliver home visits or how physician's own health may impact their delivery of home visits.

The first objective of this thesis is to describe which primary care physicians deliver home visits across regions in Ontario to patients at the end of life between fiscal years 2016-2019 and compare their characteristics to those not delivering visits. The second objective is to explore associations between physician characteristics and increased delivery of home visits in Ontario, Canada.

## Chapter 3: Methods

### 3.1 Study Population

All primary care physicians registered in the College of Physicians and Surgeons of Ontario database (CPSO) dataset from 1990 and as of March 31, 2016, who were Ontario residents that billed service codes through Ontario Health Insurance Plan Claims Database (OHIP) between April 1, 2014-March 31, 2019.



**Figure 2:** Cohort creation of primary care physicians registered in the College of Physicians and Surgeons of Ontario dataset who practiced medicine between April 1, 2014-March 31, 2019.

Physicians not registered with CPSO were excluded due to our inability to link health-related characteristics. See Figure 2 for details on the cohort creation.

### 3.2 Study Timeframe

The study is based on retrospective administrative data of home visits delivered by physicians between April 1, 2016-March 31, 2019 to patients in their last year of life (any home visit delivered within 365 days of the patient's death date).

### 3.3 Data sources

This study used provincial health administrative data housed at ICES. The cohort data was cut and merged as outlined in Figure 3. A number of datasets were linked in this study and further details on these datasets are described below.

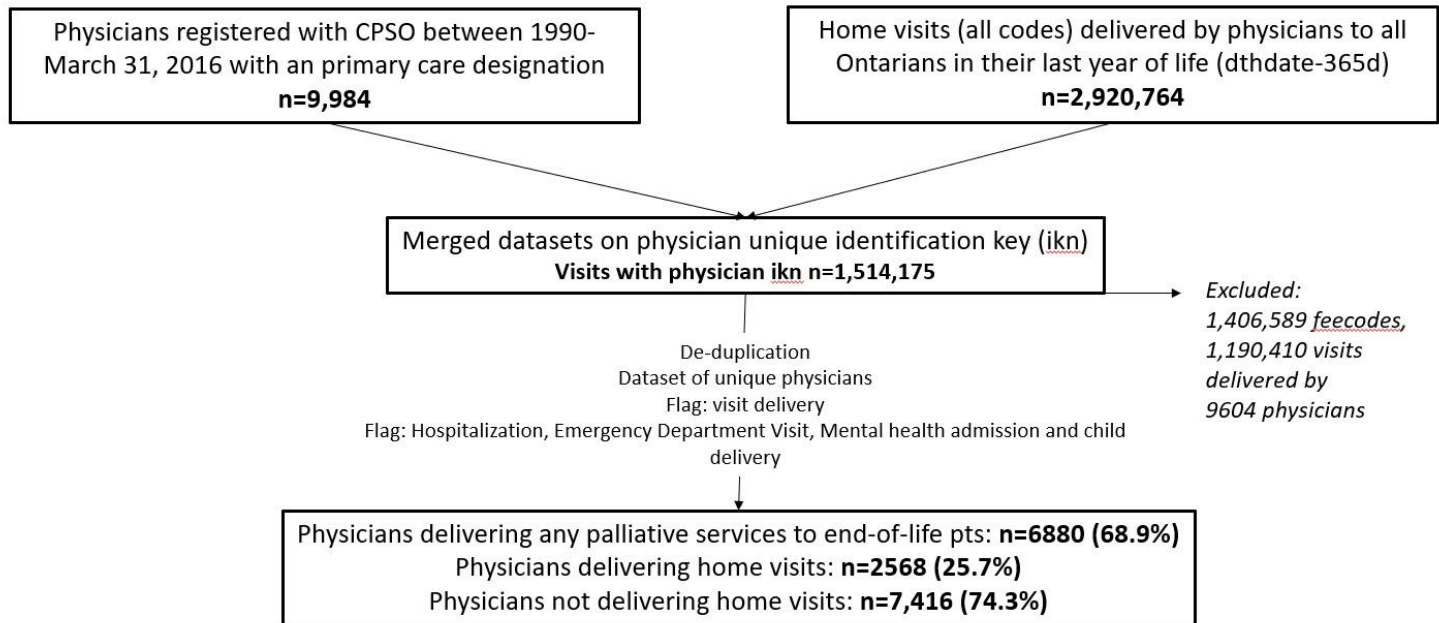


Figure 3: Flow sheet of the data merge for analysing primary care physicians delivering visits and their associated demographic, practice, and health characteristics.

#### Client Agency Program Enrolment (CAPE)

The CAPE data was used to ascertain physician capitation models. This database holds information on the provision of primary care services in Ontario. A reform of the Ontario primary care system, first piloted in 1998, established Family Health Networks (FHNs) in 2001 which are supported by the Ontario Family Health Network (OFHN) Agency. In 2003 the first Family Health Groups (FHGs) were introduced: voluntary groups of three or more physicians practice together based on the FFS plan with enhanced elements and incentives to encourage comprehensive primary care. This dataset provides information on primary care physicians' care organization and remuneration model. This data was provided by the Ontario Ministry of Health and Long-Term Care (MOHLTC).

*The Canadian Institute for Health Information/ Discharge Abstract Database (CIHI/DAD)*

The DAD was used to gather information on physician hospitalizations and health outcomes. This database includes all hospital discharges across Ontario. It includes information on the hospitalization based on a retrospective chart review including International Classification of Diseases-10 (ICD-10) diagnoses codes (up to 16 diagnoses codes for each discharge record), procedures performed during hospitalization, physician providing care, hospital administrative information, and patients' demographic information.

*College of Physicians and Surgeons of Ontario database (CPSO)*

The CPSO dataset was used to identify Ontario physicians for linkage to ICES (cohort creation) and to gather some demographic information. The CPSO is a controlled dataset recently linked and held at ICES. It includes all CPSO members who were initially registered (other than Academic Visitor and Short Duration registration classes) with the CPSO at any time from 1990 or later, whether the CPSO member is currently active or inactive. The data does not indicate if the member is inactive, therefore I used recent OHIP billing data and the IPDB to determine physicians who are currently practicing. This dataset includes simple demographics, training, registration, practice specialty, and can be linked to datasets at ICES for further variables, most importantly (for physicians themselves) hospitalizations, diagnoses codes, and other health-related information.

*ICES Physician Database (IPDB)*

The IPDB was linked to the CPSO data to find physician demographics and practice model alongside OHIP and CAPE datasets. It is an ICES derived database and includes information on Ontario physicians. Main variables in this dataset include: physician demographics, specialty, workload, services provided and location. This dataset is updated annually from the Ontario Health Insurance Plan (OHIP) Corporate Provider Database (CPDB), the Ontario Physician Human Resource Data Centre (OPHRDC) database.

*Immigration, Refugees and Citizenship Canada (IRCC)'s Permanent Resident database (CIC)*

The CIC database was used to provide information on immigration status. It includes immigration application records for individuals who originally landed in Ontario, Canada dating back to 1985. The main variables in this dataset include country of citizenship, level of education, mother tongue, and landing date. New immigrants who landed in Ontario and immediately moved to another province or those who moved from another province may not be captured in this data.

*National Ambulatory Care Reporting System (NACRS)*

The NACRS database was used to gather information on physician hospitalizations and emergency department visits. The NACRS holds data on patient visits to healthcare institutions. This includes patient demographics, the setting visited (e.g., day surgery, emergency department, cancer care unit), and clinical data (e.g., diagnosis, treatment).

*Ontario Health Insurance Plan Claims Database (OHIP)*

The OHIP database was used to identify the currently active physicians (cohort creation), physician home visit delivery, physician billing patterns, and health related claims billed for the physician's own care. The OHIP database holds all billing claims paid for by the Ontario Health Insurance Plan. The two main physician compensation plans in Ontario are the fee-for-service plan (FFS) and the alternative funding plan (AFP) for those who belong to group practices with patient enrollment remuneration. Even for those who are in a mainly capitation model (e.g., receiving a set dollar amount for each patient rostered – differing by age and sex – plus a small proportion of the FFS billing amount), they are required to submit shadow-billing claims for services rendered (with only a small proportion such as 10% or \$0.00 payment amount) to track utilization of services. Each record represents the delivery of a service from a particular physician to a particular patient and includes the date, the fee paid, and the number of times it was billed.

*Registered Persons Database (RPDB)*

The RPDB was used to capture information on physician demographics. It is a database that holds information on each individual who has ever had an active Ontario health card number. This data was

provided by the Ministry of Health and Long-Term Care (MOHLTC). The most relevant information in this dataset are demographic information, geographic information, and eligibility of OHIP coverage.

*Corporate Providers Database (CPDB)*

The CPDB provided further information on physician's demographic information and geographic location. It provides information on physicians and some non-physicians (including chiropractors, physiotherapists, and optometrists) funded by the Ontario MOHLTC. Variables in the dataset include demographic, eligibility, specialty, and practice location.

*Statistics Canada's Postal Code Conversion File Plus (PCCF+)*

This is an ICES derived macro designed to link PCCF files to other census geographic identifiers and was used to determine physicians' geographic characteristics including CMA size, rurality, and local health integration networks. The variables include urban/rural flags, neighbourhood income quintiles, dissemination area/enumeration area, census division, and latitude/longitude. This macro is updated according to changes in census data from which it is derived.

*ICES Database on Delivering Mother and Newborns (MOMBABY)*

MOMBABY was used to determine child births and link the female physicians to their child deliveries. MOMBABY is an ICES derived dataset capturing the characteristics of deliveries, newborns and mothers in Ontario. It is updated annually and provides information on the hospital treatment records as well as mother and baby demographic information.

### 3.4 Study variables and covariates

#### 3.4.1 Primary outcome

##### Home visits

The primary outcome for this analysis was any home visit delivered between April 1, 2016-March 31, 2019 to patients during their last year of life. Home visits were captured using OHIP billing codes for home visits (Appendix I). Figure 4 demonstrates how home visits were calculated based on encounters which was captured by looking at the OHIP billing codes per day per physician and for each unique patient.

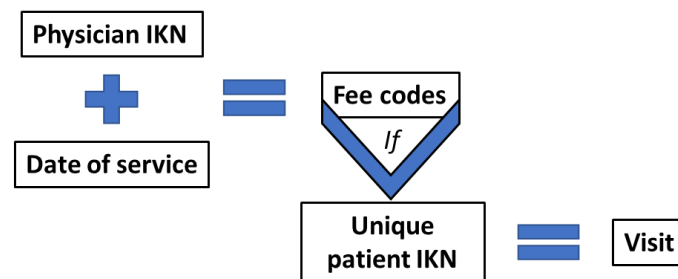


Figure 4: Logic map for visit definition

#### 3.4.2 Covariates

Several factors may influence a physician's delivery of home visit. This descriptive analysis inspects some of the previously researched factors along with more novel covariates. I have outlined the physician-centred variables in three categories: 1) physician demographics, 2) physician health characteristics, and 3) physician practice characteristics.

##### 3.4.2.1 Physician demographic characteristics

Physician's own characteristics may be crucial to the delivery of home visits to patients who are at the end of their life. The current literature suggests physician demographics influence their propensity to delivery home visits. We investigated and controlled for the physician's characteristics that may influence their delivery of home visits.

### *Age and sex*

Physicians' age is a continuous variable from the RPDB at index date (March 31, 2016). Physicians' sex is a categorical variable from the RPDB at index date and is dichotomized as male and female.

### *Income Quintile*

Income quintile of the physician was imputed from median neighborhood income of the physician's principal residence at index date (March 31, 2016), using the Statistics Canada Postal Code Conversion File (PCCF).

### *Rurality*

The rurality of a physician may impact the practice patterns of a physician as there are fewer resources and often larger distances to travel. Conversely, a physician practicing in a rural may have a more comprehensive practice that includes caring for their patients regardless of where they reside (e.g., including in hospital, in long-term care, or in their homes). A physician was categorized as rural if they live in a community with a population of fewer than 10,000 residents.<sup>(96)</sup> This variable was chosen as a binary variable as there are known differences in resource availability between urban and rural jurisdictions for healthcare and other publicly funded services.

### *Immigrant status: recent immigrant*

Physician's immigrant status was acquired from the IRCC and physicians were deemed recent immigrants if their landing date was within 20 years of the index date (if it occurred between 1986-2016).

#### *3.4.2.2 Physician's Personal Health Characteristics*

Although there is research on physician demographics and practice patterns, this is the first study capturing health characteristics of the physicians themselves. These variables are indicative of serious health events that may impact a physician's ability to deliver services, especially services that may

require additional time, travel and coordination. I use these descriptive variables to explore associations between significant personal health events and home visit delivery. I chose emergency department visits as they are measures of a serious health event that may impact a physicians' ability to practice at full capacity. Similarly, since previous research found male physicians delivered home visits more than their female counterparts, it was suggested that female physicians with young children may be responsible for this sex difference – as there is a perception that this would reduce hours of work and reduce availability for after hours call. I wanted to inspect this particular variable to confirm or dispel this notion.

#### *Comorbidities*

Each physician's co-morbidities are captured using a macro developed at ICES for previous research and is based on the individual's healthcare utilization for treatment of 18 common chronic conditions. The details of case ascertainment are described elsewhere.(97-102)

#### *Emergency Department Visits*

Physicians who themselves visited the emergency department were captured using data from the NACRS dataset based on an arrival date (ARRIVALDATE) that occurred within the study period. There is significant missingness in the documentation of arrival date (>60%) to the emergency department in the ICES data holdings. (103)

#### *Hospital Admission*

Physicians who themselves were admitted to hospital during the study period data was captured from the DAD using the admission date (ADMDATE). Admission to hospital is well documented with 0.0% missingness in the ICES data since 1988.(104)

#### *Recent Child Delivery*

Female physicians who delivered a child in Ontario and who were eligible for OHIP during the study period data was captured from an ICES derived dataset (MOMBABY) during the study period. This was

captured using the mother's discharge date (M\_DDATE) which is taken from the DAD and is well documented with 0.0% missingness since 1988.(105) Unfortunately, data on male physicians with young children could not be obtained in this data; however, this is a future area to consider as parents of newborn or young children – both male and female – may show changes in practice.

#### *3.4.2.3 Physician's practice characteristics*

The characteristics of a physician's training, practice length, and practice patterns were investigated and controlled for in the analysis to understand if there is an association between delivering home visits and other aspects of an individual's professional circumstances.

##### *Length of practice*

The length of practice was based on the physician's year of graduation from medical school captured in the CPSO registration and calculated for number of years physicians have been practicing (including residency) on March 31, 2016.

##### *Census Metropolitan Area (CMA) Size*

This variable describes the size of the community within which a physician's office is situated. The size of communities within Canada are categorized by Statistics Canada according to their size and location. A census metropolitan area (CMA) or a census agglomeration (CA) is formed by one or more adjacent municipalities centred on a population centre.(96) Statistics Canada reported 147 CMA and CAs in the 2011 census.(106) This variable informs a more detailed understanding of the area within which a physician is practicing.

##### *Palliative care designation*

Physicians who billed any palliative codes were categorized using a validated algorithm to identify palliative care physicians through administrative data based on proportions of billing.(53, 107) Physicians with greater than 10% billings in palliative care are categorized as a specialist and those with less than 10% billings in palliative care are generalists. Since palliative care was not recognized

as a specialty in administrative data, this algorithm is necessary to understand which physicians consider palliative care as a part of their practice.

### *Remuneration*

Previously in Ontario,(108) primary care was based on a fee-for-service remuneration model for solo practitioners and has been redesigned to include group-based practices focused on patient enrollment and comprehensive care. This variable was acquired through the IPDB and is based on the group affiliation of the physician. It is divided into physicians who belong to capitation model, enhanced fee-for-service, and traditional fee-for-service. **Capitation models** include Family Health Organizations (FHO) and Family Health Networks (FHN) which have physicians practicing in groups and compensated primarily through lump sum payments based on the number of enrolled patients with pre-determined amounts based on patient's age and sex. They also receive full fee-for-service payments for services that are outside (i.e., 'out of basket') of the typical care scope (e.g., palliative care services). **Enhanced Fee-For-Service models** include Comprehensive Care Models (CCM) for solo practitioners and Family Health Groups (FHG) for groups which have physicians primarily compensated on a fee-for-service schedule of benefits with smaller incentives for patient enrollment and comprehensive care. **Traditional Fee-For-Service** includes those practicing solo and receiving compensation through the fee-for-service model. This category also includes those who do not belong to the other specialized groups.(108) Physicians not paid through OHIP were not included in this analysis, including physicians with salaried appointments (e.g., in Community Health Centers). This study captured home visits delivered to patients in their last year of life which are special premiums, with codes (Appendix I) compensated 'out-of-basket' (services compensated outside of the monthly capitation payment physicians receive for each enrolled patient) as a fee-for-service model.

#### *Travel distance*

Distance between locations is not accurately captured in ICES, therefore we used the clinic location's postal code (as a proxy) and patient's postal codes to derive the Euclidean distance (i.e., straight line distance) as a measure of a geographic barrier to delivering patient care.

#### *Previous encounters*

Physicians' OHIP billing history was captured one year prior to the study index date (March 31, 2021) and the number of home visits delivered to any patients (not only those in the last year of life) was captured. This variable is intended to flag whether the physician travels to any patient's home, regardless of their end-of-life status, and is a measure of the volume of home visit deliveries to understand each physician's propensity to delivery visits.

#### *International training*

International training was captured using IPDB and the binary variable for international training. This variable indicates whether the physician attended a Canadian medical school or received international medical training before beginning a residency in Canada.

#### *Local Health Integration Network (LHIN)*

Ontario was previously divided into 14 health networks to distribute the organization of healthcare, until 2019 when the provincial government announced they would merge these networks into a centralized health network. We used previously developed algorithms at ICES and Statistics Canada to define the physician's residences according to the appropriate LHIN based on postal code.

#### *Roster size*

This variable measures the number of patients enrolled to physicians who belong to remuneration models with capitation. It was captured by calculating the number of patients registered to each unique physician ID in CAPE.

### 3.5 Exploratory analysis

The exploratory analysis calculated the means, medians, distributions, and standard deviations for continuous variables such as physician's age, years of practice, and number of previous home encounters. Frequency and proportions were calculated for binary and categorical variables such as sex, income quintile, rurality, immigrant status, international training, palliative care designation, comorbidities, previous ED or hospitalizations, LHIN, CMA size, remuneration model, and childbirths for practicing female physicians.

Associations between the primary outcome and continuous covariates were calculated using a student's t-test for normally distributed variables, a Wilcoxon rank sum (Mann-Whitney) test was used for not-normally distributed variables, and a chi-square test of independence was used for categorical variables. Collinearity or interdependence between continuous variables was assessed using Pearson's correlation coefficient and plotted for visually linear relationships between continuous variables. For collinearity between continuous and categorical variables, t-test results and crude odds ratios were assessed.

### 3.6 Statistical analysis

The statistical analysis was descriptive and hypothesis-generating. Using a logistic regression model, this analysis compared physicians who delivered home visits to those who did not deliver home visits during the study period to calculate the odds of physicians delivering a home visit according to their characteristics.

A multivariable logistic regression model was fitted to calculate the odds of physicians delivering home visits to patients in their last year of life based on the exploratory results. Crude odds ratios were calculated for each covariate and the final model was determined using variables with statistically significant p-values of 0.05 or less. The final parsimonious model was fitted with clinically

relevant and statistically significant variables. Clinically relevant variables were determined *a priori* based on previous literature (19-21, 30, 31) and were: age, sex, rurality, and previous home visit experience.

## Chapter 4: Which primary care physicians deliver home visits to their dying patients in Ontario? A retrospective cohort study describing physician characteristics associated with delivering home visits to patients in the last year of life.

*Please note: This chapter is the completed manuscript that will be submitted for publication in a peer-reviewed journal, therefore there will be redundancies in the introduction, methods, and discussion sections.*

### 4.1 Introduction

Home visits (also called ‘house calls’) from physicians, a practice that historically was a significant part of family medicine, have become less common.(19) Home visits from physicians as patients approach the end of life, defined as the last year of life, have been shown to increase likelihood of dying at home, increase satisfaction with care, and reduce acute care utilization.(13, 16, 56, 109) Home visits are also associated with improved healthcare quality, reduced population cost of preferential care, and the enablement a ‘good death’ experience for Canada’s aging population.(44, 64, 110) Most patients at the end of life prefer care at home,(1, 9, 111-114) which is a location that requires additional supports as a patient’s condition worsens.(115) Yet, a study in Ontario found that only 1 in 5 of people received a physician home visit in their last year of life – an important part of providing the necessary medical support to keeping patients at home.(16)

A decline in physicians delivering home visits has been observed during the second half of the 20<sup>th</sup> century across the United States (U.S.), Canada, and Europe.(19, 21, 116, 117) Yet, as many countries face an aging population, interest in home visits has returned.(24, 64) Physician characteristics associated with increased propensity to deliver home visits include being male, older age, being specialized in primary

care, geriatrics or osteopathy, having a solo practice, living in a rural area, and experience practicing in community settings.(19-21, 30, 31) These studies are also not specific to end-of-life populations which may influence physician characteristics and their rationale for visiting patients. Furthermore, there are a number of physician characteristics that have not been explored in association with home visit delivery including remuneration model and physician's own health characteristics.

Existing literature on home visits can be summarized according to both patient- and physician-related factors. The majority of studies have focused on characteristics and outcomes associated with patients receiving a physician home visit; for example, many studies found the likelihood of dying at home increased with physician home visits and patients diagnosed with cancer had a higher likelihood of receiving a home visit.(9-16, 118) Research on characteristics and practice patterns of physicians delivering end-of-life home visits is scarce.(27, 31, 94) Our objectives are to describe and explore the association between characteristics of primary care physicians, including inspecting physicians as patients by exploring health characteristics that may influence their practice patterns, and their propensity to provide home visits to patients who are in their last year of life in Ontario, Canada.

## 4.2 Methods

### *Study population and data sources*

We conducted a retrospective population-based cohort study using population data housed at ICES to describe home visits delivered by primary care physicians. ICES is an independent, non-profit research institute whose legal status under Ontario's health information privacy law allows it to collect and analyze health care and demographic data, without consent, for health system evaluation and improvement.

Physician home visits were captured using billings in the Ontario Health Insurance Plan Claims Database (OHIP), which has been linked to the College of Physicians and Surgeons of Ontario (CPSO) database to identify newly registered primary care physicians in Ontario between January 1, 1990-December 31, 2016. Figure 1 is a flow diagram of the study cohort which included all primary care

physicians registered in the College of Physicians and Surgeons of Ontario database (CPSO) dataset from January 1, 1990 and as of March 31, 2016, who were Ontario residents that billed service codes through Ontario Health Insurance Plan Claims Database (OHIP) between April 1, 2014-March 31, 2019. Exclusions were those with an invalid OHIP registration, birthdate, or ICES unique identification number.

Physicians were characterized according to demographics, practice characteristics and physicians' own history of acute care encounters. Appendix III outlines the datasets and associated variables used to describe and analyze physicians and their association to home visits. These datasets were linked using unique encoded identifiers and analyzed at ICES.

#### *Study variables*

The primary outcome for this analysis was home visits provided to patients in their last year of life between April 1, 2016-March 31, 2019. Home visits were captured using OHIP codes billed by a physician for the care of a patient in their home on a unique day (Appendix 1). Multiple codes billed by the same physician for the same patient on the same day were counted as one encounter. All variables for the analysis are described in Appendix III alongside the database from which they were obtained. All study variables are physician-related and includes the providing physicians' demographics as their age, sex, income quintile, and rurality. Physician health characteristics include chronic conditions, recent emergency department visits (records within the previous two years), recent hospitalizations (records within the previous two years), and any record of childbirth for female physicians who lived in Ontario. Physicians' professional practice characteristics include palliative care designation, population size of practice location according to resident density within census metropolitan areas (CMAs), Local Health Integration Network (LHIN), and remuneration model. Population density was categorized according to the Canadian Chronic conditions were identified based on healthcare utilization and diagnosis codes. Using previously developed algorithms, described and validated in previous work,(97-102) the presence

of active conditions was determined using records within the previous three years and a lifetime lookback was used to identify if a chronic condition was ever recorded. Palliative care has not been recognized as a specialty in Canada until recently. In this study, we used a validated algorithm designed to identify palliative care physicians in health administrative data.(53) The algorithm categorizes physicians based on the proportion of their billings represented by palliative care in the previous two years of practice; physicians with billings using a palliative care fee code that represented  $\geq 10\%$  of their practice were defined as palliative care specialists, and those with  $< 10\%$  of their billings using a palliative care fee code were considered as generalists. Rurality of physicians' practice locations was categorized into five groups (Table 1) based on population density.(96)

#### *Remuneration models*

In Canada, physicians are remunerated through each province's public and universal health insurance plan. Fee-for-service remuneration, where primary care physicians are compensated based on the number of procedures or services they provide, is the predominant remuneration model (representing over 89% of physicians).(119) Other remuneration models include a blended model of payment with mainly fee-for-service compensation but also an incentive payment for enrolled patients to physicians in a Family Health Group (FHG) or a Comprehensive Care Model (CCM). Remuneration in capitation models compensate physicians through monthly payments for patient enrollment (i.e., based on the age and sex of the patient) in practices with three or more physicians who belong to a Family Health Network (FHN) or Family Health Organization (FHO).(120) We analyzed remuneration according to three groups: traditional fee-for-service, enhanced fee-for service, and mainly capitation models.(121)

In this study, we captured home visits delivered to patients in their last year of life; fee codes for home visits (Appendix I) are compensated 'out-of-basket' (i.e., services compensated outside of the

monthly capitation payment physicians receive for each enrolled patient) in a similar manner as a fee-for-service model.

### *Statistical methods*

We conducted a descriptive analysis comparing physicians who delivered home visits to those who did not deliver home visits during the study period. Our exploratory analysis calculated the means, medians, distributions, and standard deviations for continuous variables. Frequency and proportions were calculated for binary and categorical variables.

A crude rate of visits per physician was calculated using the number of home visits delivered during the study period over the number of decedents during the study period between 2016-2019 (Appendix II). The rate was calculated and displayed geographically according to the 14 LHINs across Ontario.

A multivariable logistic regression model was fitted to calculate the odds of physicians delivering home visits to patients in their last year of life based on the exploratory results and variables identified in previous literature. Crude odds ratios were calculated for each covariate. The final parsimonious model was fitted with clinically relevant (based on variables found statistically significant and explained in previous literature (19-21, 30, 31)) and statistically significant variables: age, sex, CMA size of physicians practice location, international training, palliative care designation, previous number of home encounters, remuneration model, and Local Health Integration Network (LHIN). Since large cities have been previously found associated with lower visit rates,(94) we used the Mississauga Halton region as our reference LHIN. The reference category for the CMA size was chosen as areas with 9,000-99,999 residents since very rural areas had a smaller sample size and has previously been shown associated with increased home visit delivery.

### *Ethics*

This project was approved by the Research Ethics Board at The Ottawa Hospital Research Institute (CRRF ID: 1925).

### 4.3 Results

#### Overview

This analysis included 9,984 primary care physicians registered with the CPSO between January 1, 1990 and March 31, 2016 and practicing in Ontario as of March 31, 2016. Figure 2 outlines the cohort creation and Table 1 shows the baseline characteristics of the cohort.

<b>Table 1: Physician characteristics of primary care physicians between 2016-2019</b>	
	<b>N=9984</b>
Age (Mean $\pm$ SD)	41.44 $\pm$ 9.72
Age (Median (IQR))	41 (33-49)
<b>Age (categorical)</b>	
Years 18-29	739 (7.4%)
Years 30-39	3,831 (38.4%)
Years 40-49	3,229 (32.3%)
Years 50-59	1,804 (18.1%)
Years 60-69	328 (3.3%)
Years 70+	53 (0.5%)
<b>Sex</b>	
Male	4,598 (46.1%)
Female	5,386 (53.9%)
<b>Neighbourhood Income Quintile</b>	
1	813 (8.1%)
2	1,140 (11.4%)
3	1,419 (14.2%)
4	2,022 (20.3%)
5	4,571 (45.8%)
Missing	1-20 (0.2%)
<b>Rurality</b>	
Urban	9,228 (92.4%)
Rural	737 (7.4%)
Long-standing Resident	7,960 (79.7%)
Recent Immigrant (i.e., since 1985)	2,024 (20.3%)
<b>International Medical Graduate</b>	
Missing	2,066 (20.7%)

Canadian Medical Graduate	5,819 (58.3%)
International Medical Graduate	2,099 (21.0%)
<b>Remuneration model</b>	
Enhanced Fee-for-Service (FFS) (FHG)	1,950 (19.5%)
Mainly Capitation (FHO)	3,452 (34.6%)
Traditional Fee-For-Service	4,582 (45.9%)
<b>Years since medical school graduation (Mean ± SD)</b>	
Years since graduation (Median (IQR))	14.81 ± 9.91 14 (6-23)
<b>Palliative care designation</b>	
Specialist (i.e., >10% of billings in palliative care)	250 (2.5%)
Generalist (i.e., at least 1 palliative care billing but less than 10% of billings in palliative care)	4,716 (47.2%)
None (i.e., no palliative care billing in the study period)	5,018 (50.3%)
<b>No admissions to mental health institution in previous 2 years</b>	
Admission to mental health institution	9,921 (99.4%) 63 (0.6%)
<b>No emergency department visits in previous 2 years</b>	
Emergency department visit	4,700 (47.1%) 5,284 (52.9%)
<b>No hospitalization in previous 2 years</b>	
Hospitalization	7,304 (73.2%) 2,680 (26.8%)
<b>No record of childbirth</b>	
1 or more records of childbirth in Ontario (previous 18 years)	6,953 (69.6%) 3,031 (30.4%)
<b>CMA/CA size</b>	
1,250,000+	4,211 (42.2%)
1,249,999-500,000	1,805 (18.1%)
499,999-100,000	2,046 (20.5%)
99,999 - 9,000	855 (8.6%)
Rural/Small town	892 (8.9%)
Missing	175 (1.8%)
<b>LHIN of practice address</b>	
1. Erie St. Claire	342 (3.4%)
2. South West	720 (7.2%)
3. Waterloo Wellington	549 (5.5%)
4. Hamilton Niagara Haldimand Brant	914 (9.2%)
5. Central west	529 (5.3%)
6. Mississauga Halton	859 (8.6%)
7. Toronto Central	1,280 (12.8%)
8. Central	1,182 (11.8%)
9. Central East	850 (8.5%)
10. South East	405 (4.1%)
11. Champlain	1,215 (12.2%)
12. North Simcoe Muskoka	356 (3.6%)
13. North East	490 (4.9%)
14. North West	279 (2.8%)
Missing	14 (0.1%)

<b>Number of home-based encounters in year before index</b>	
(Mean ± SD)	19.45 ± 35.92
(Median (IQR))	7 (2-20)
<b>Prevalent conditions, active (previous 2 years)</b>	
0	6,808 (68.2%)
1	2,369 (23.7%)
2	614 (6.1%)
3	147 (1.5%)
4	33 (0.3%)
5+	13 (0.1%)
<b>Prevalent conditions, ever (</b>	
0	3,552 (35.6%)
1	3,152 (31.6%)
2	1,919 (19.2%)
3	875 (8.8%)
4	349 (3.5%)
5+	137 (1.4%)
<b>Size of physician roster (Mean ± SD)</b>	
(Median (IQR))	1,115.75 ± 732.34 1,032 (666-1,500)

There were 2,568 (25.7%) physicians who delivered at least one home visit and 7,416 (74.3%) who did not deliver any home visits during their patients' last year of life (Table 2). A total of 181,147 home visits were delivered during the study period with a mean number of 70.5 visits per physician (standard deviation (STD): 300.3) across those delivering visits. Over half (53.9%) the physicians in the cohort were female and the mean age was 41.4 (STD ±9.7). The distribution of age was right skewed with the largest proportion of physicians (38.4%) aged 29-39 years in this cohort. Physicians with one or more visits to the emergency department in the previous two years showed a statistically significant ( $p < 0.001$ ) reduction in home visits (48.6% versus 52.9% overall) and physicians with any record of chronic conditions were associated with home visit delivery ( $p 0.02$ ). Other physician health characteristics did not significantly change subsequent delivery of home visits in the tests of association. Those with prevalent health conditions ( $p 0.54$ ) compared to those without prevalent conditions, those with previous hospitalizations compared to those with recent hospitalizations ( $p 0.88$ ) showed no significant relationship to home visit delivery and female physicians with previous or current childbirth showed no significant difference ( $p$

0.15) in home visit practices. A higher proportion (24.1%) of internationally trained physicians delivered home visits than those trained within Canada (20.0%).

<b>Table 2: Physician characteristics of those delivering home visits to patients in their last year of life compared to those not delivering visits between 2016-2019</b>						
<b>Variable</b>	<b>No home visit delivered (n)</b>	<b>%</b>	<b>Home visits delivered (≥1)</b>	<b>%</b>	<b>TOTAL</b>	<b>p-value</b>
	<b>7,416 (74.3%)</b>		<b>2,568 (25.7%)</b>		<b>9984</b>	
Age (Mean ± SD)	41.16 ± 9.64		42.25 ± 9.92		41.44 ± 9.72	<.001
Age (Median (IQR))	40 (33-48)		42 (34-50)		41 (33-49)	<.001
<b>Age (categorical)</b>						<.001
Years 18-29	576	77.94%	163	22.06%	739	
Years 30-39	2,906	75.85%	925	24.15%	3,831	
Years 40-49	2,412	74.70%	817	25.30%	3,229	
Years 50-59	1,264	70.07%	540	29.93%	1,804	
Years 60-69	230	70.12%	98	29.88%	328	
Years 70+	37	69.81%	16	30.19%	53	
<b>Sex</b>						0.421
Male	3,437	74.75%	1,161	25.25%	4,598	
Female	3,988	74.04%	1,398	25.96%	5,386	
<b>Neighbourhood Income Quintile</b>						0.51
Missing	0		<=5		0	
1	617	75.89%	196	24.11%	813	
2	849	74.47%	291	25.53%	1,140	
3	1,048	73.85%	371	26.15%	1,419	
4	1,474	72.90%	548	27.10%	2,022	
5	3,422	74.86%	1,149	25.14%	4,571	
<b>Rurality</b>						<.001
Urban	6,910	74.88%	2,318	25.12%	9,228	
Rural	500	67.84%	237	32.16%	737	
Missing	1-20 (0.2%)		<=5		1-20	
Canadian born	5,949	74.74%	2,011	25.26%	7,960	
Immigrant	1,476	72.92%	548	27.08%	2,024	
<b>International Medical Graduate</b>						<.001
Missing	1,606	77.73%	460	22.27%	2,066	
Canadian Medical Graduate	4,336	74.51%	1,483	25.49%	5,819	
International Medical Graduate	1,483	70.65%	616	29.35%	2,099	
<b>Remuneration model</b>						<.001
Enhanced FFS (FHG)	1,328	68.10%	622	31.90%	1,950	

Mainly Capitation (FHO)	2,154	62.40%	1,298	37.60%	3,452	
Traditional FFS	3,943	86.05%	639	13.95%	4,582	
<b>Years since graduation (Mean ± SD)</b>	14.53 ± 9.83		15.62 ± 10.11		14.81 ± 9.91	<.001
Years since graduation (Median (IQR))	13 (6-22)		15 (7-24)		14 (6-23)	<.001
<b>Palliative care designation*</b>						<.001
Specialist (i.e., >10% of billings in palliative care)	167	66.80%	83	33.20%	250	
Generalist (i.e., at least 1 palliative care billing but less than 10% of billings in palliative care)	3,015	63.93%	1,701	36.07%	4,716	
None (i.e., no palliative care billing in the study period)	4,243	84.56%	775	15.44%	5,018	
<b>No admissions to mental health institution**</b>	7,377	74.36%	2,544	25.64%	9,921	9,921
Admission to mental health institution	48	76.19%	15	23.81%	63	
<b>No emergency department visits**</b>	3,385	72.02%	1,315	27.98%	4,700	<.001
Emergency department visit	4,040	76.46%	1,244	23.54%	5,284	
<b>No hospitalizations**</b>	5,429	74.33%	1,875	25.67%	7,304	0.88
Hospitalization	1,996	74.48%	684	25.52%	2,680	
<b>No childbirth recorded during study period or before</b>	5,200	74.79%	1,753	25.21%	6,953	0.147
Childbirth recorded during study period or before	2,225	73.41%	806	26.59%	3,031	
<b>CMA/CA size</b>						<.001
1,250,000+	3,220	76.47%	991	23.53%	4,211	
1,249,999-500,000	1,279	70.86%	526	29.14%	1,805	
499,999-100,000	1,530	74.78%	516	25.22%	2,046	
99,999 - 9,000	652	76.26%	203	23.74%	855	
Rural/Small town	620	69.51%	272	30.49%	892	
Missing	124	70.86%	51	29.14%	175	
<b>LHIN of practice address</b>						<.001
1. Erie St.Claire	280	81.87%	62	18.13%	342	
2. South West	523	72.64%	197	27.36%	720	
3. Waterloo Wellington	390	71.04%	159	28.96%	549	
4. Hamilton Niagara Haldimand Brant	604	66.08%	310	33.92%	914	
5. Central west	405	76.56%	124	23.44%	529	
6. Mississauga Halton	675	78.58%	184	21.42%	859	
7. Toronto Central	994	77.66%	286	22.34%	1,280	
8. Central	862	72.93%	320	27.07%	1,182	
9. Central East	652	76.71%	198	23.29%	850	

10. South East	286	70.62%	119	29.38%	405	
11. Champlain	879	72.35%	336	27.65%	1,215	
12. North Simcoe Muskoka	256	71.91%	100	28.09%	356	
13. North East	374	76.33%	116	23.67%	490	
14. North West	234	83.87%	45	16.13%	279	
Missing	11		<=5		14	
<b>Number of home-based encounters in year before index (Mean ± SD)</b>	14.28 ± 28.29		24.27 ± 41.22		19.45 ± 35.92	19.45 ± 35.92
(Median (IQR))	4 (2-13)		10 (3-27)		7 (2-20)	7 (2-20)
<b>Prevalent conditions, active**</b>	5,039	74.02%	1,769	25.98%	6,808	0.542
1	1,792	75.64%	577	24.36%	2,369	
2	455	74.10%	159	25.90%	614	
3	106	72.11%	41	27.89%	147	
4	24	72.73%	9	27.27%	33	
5+	8	61.54%	13	100.00%	13	
<b>Prevalent conditions, ever</b>	2,645	74.47%	907	25.53%	3,552	0.016
1	2,300	72.97%	852	27.03%	3,152	
2	1,436	74.83%	483	25.17%	1,919	
3	667	76.23%	208	23.77%	875	
4	279	79.94%	70	20.06%	349	
5+	89	64.96%	48	35.04%	137	
<b>Size of physician roster (Mean ± SD)</b>	1,082.20 ± 758.61		1,176.59 ± 678.11		1,115.75 ± 732.34	<.001
(Median (IQR))	998 (606-1,462)		1,084 (743-1,539)		1,032 (666-1,500)	<.001

Legend: FFS=Fee-for-service, IQR=Interquartile range, SD=Standard Deviation, CMA=Census Metropolitan Area/CA=Census Agglomeration

\*Palliative care designation calculated from practice billings during the study period (2016-2019)

\*\*Using a lookback window of 2 years from index date

#### Remuneration

Physician demographics, characteristics and practice patterns differed across remuneration models (Table 3). Just over half (50.7%) of those delivering home visits belonged to a mainly capitation remuneration model, to which 34.6% of the physician cohort belonged. Physicians practicing within enhanced fee-for-service models made up 24.3% of those delivering end-of-life home visits, with 19.5% of the overall cohort of physicians within this remuneration model. One quarter (25.0%) of the physicians

delivering home visits belonged to a traditional fee-for-service, which almost half (45.9%) of the cohort used as their practice model.

Primary physicians who were defined as palliative care specialists were more likely to practice according to a traditional fee-for-service model (3.4% versus 2.5% overall). Physicians deemed palliative care generalists had a higher proportion practicing in a mainly capitation model (73.5% versus 47.2% overall). A 19.3% higher proportion of palliative care generalists delivered home visits (66.5% versus 47.2% overall) than palliative care specialists (3.2% versus 2.5% overall).

**Table 3: Physician characteristics according to their practice remuneration model**

<b>Variable</b>	<b>Enhanced FFS</b>	<b>Mainly Capitation</b>	<b>Traditional FFS</b>	<b>TOTAL n=9984</b>	<b>P-value</b>
<b>Age (categorical)</b>					
Years 18-29	14 (0.7%)	28 (0.8%)	697 (15.2%)	739 (7.4%)	<.001
Years 30-39	495 (25.4%)	1,287 (37.3%)	2,049 (44.7%)	3,831 (38.4%)	
Years 40-49	786 (40.3%)	1,318 (38.2%)	1,125 (24.6%)	3,229 (32.3%)	
Years 50-59	499 (25.6%)	718 (20.8%)	587 (12.8%)	1,804 (18.1%)	
Years 60-69	136 (7.0%)	91 (2.6%)	101 (2.2%)	328 (3.3%)	
Years 70+	20 (1.0%)	10 (0.3%)	23 (0.5%)	53 (0.5%)	
<b>Sex</b>					
Male	947 (48.6%)	1,474 (42.7%)	2,177 (47.5%)	4,598 (46.1%)	<.001
Female	1,003 (51.4%)	1,978 (57.3%)	2,405 (52.5%)	5,386 (53.9%)	
<b>Neighbourhood Income Quintile</b>					
Missing	<=5 (0.1%)	1-10 (0.2%)	10 (0.2%)	19 (0.2%)	<.001
1	120-150 (6.0%)	229 (6.6%)	467 (10.2%)	813 (8.1%)	
2	180 (9.2%)	321 (9.3%)	639 (13.9%)	1,140 (11.4%)	
3	254 (13.0%)	449 (13.0%)	716 (15.6%)	1,419 (14.2%)	
4	464 (23.8%)	678 (19.6%)	880 (19.2%)	2,022 (20.3%)	
5	933 (47.8%)	1,768 (51.2%)	1,870 (40.8%)	4,571 (45.8%)	
<b>Rurality</b>	<=5 (0.1%)	1-10 (0.2%)	10 (0.2%)	19 (0.2%)	<.001
Urban	1,893 (97.1%)	3,025 (87.6%)	4,310 (94.1%)	9,228 (92.4%)	
Rural	55 (2.8%)	420 (12.2%)	262 (5.7%)	737 (7.4%)	
<b>Canadian born</b>	1,237 (63.4%)	2,853 (82.6%)	3,870 (84.5%)	7,960 (79.7%)	<.001
Immigrant	713 (36.6%)	599 (17.4%)	712 (15.5%)	2,024 (20.3%)	
<b>International Medical Graduate</b>					
Missing	119 (6.1%)	138 (4.0%)	1,809 (39.5%)	2,066 (20.7%)	<.001
Canadian Medical Graduate	884 (45.3%)	2,577 (74.7%)	2,358 (51.5%)	5,819 (58.3%)	
International Medical Graduate	947 (48.6%)	737 (21.3%)	415 (9.1%)	2,099 (21.0%)	
<b>Years since graduation (Mean ± SD)</b>	20.05 ± 9.60	16.26 ± 8.53	11.49 ± 9.79	14.81 ± 9.91	<.001
<b>Years since graduation (Median (IQR))</b>	20 (13-26)	16 (9-23)	8 (3-19)	14 (6-23)	<.001
<b>Palliative care designation *</b>					<.001
Specialist (i.e., >10% of billings in palliative care)	34 (1.7%)	60 (1.7%)	156 (3.4%)	250 (2.5%)	
Generalist (i.e., at least 1 palliative care billing but less than 10% of billings in palliative care)	891 (45.7%)	2,537 (73.5%)	1,288 (28.1%)	4,716 (47.2%)	
None (i.e., no palliative care billing in the study period)	1,025 (52.6%)	855 (24.8%)	3,138 (68.5%)	5,018 (50.3%)	
<b>No admissions to mental health institution**</b>	1,929 (98.9%)	3,433 (99.4%)	4,559 (99.5%)	9,921 (99.4%)	0.021
Admission to mental health institution	21 (1.1%)	19 (0.6%)	23 (0.5%)	63 (0.6%)	
<b>No emergency department visits**</b>	1,104 (56.6%)	1,781 (51.6%)	1,815 (39.6%)	4,700 (47.1%)	<.001
Emergency department visit	846 (43.4%)	1,671 (48.4%)	2,767 (60.4%)	5,284 (52.9%)	
<b>No hospitalizations**</b>	1,475 (75.6%)	2,443 (70.8%)	3,386 (73.9%)	7,304 (73.2%)	<.001
Hospitalization	475 (24.4%)	1,009 (29.2%)	1,196 (26.1%)	2,680 (26.8%)	
<b>Delivery of 1 or more children</b>	1,413 (72.5%)	2,138 (61.9%)	3,402 (74.2%)	6,953 (69.6%)	<.001
Delivery of 1 or more children	537 (27.5%)	1,314 (38.1%)	1,180 (25.8%)	3,031 (30.4%)	
<b>CMA/CA size</b>					
1,250,000+	0 (0.0%)	0 (0.0%)	14 (0.3%)	14 (0.1%)	<.001
1,249,999-500,000	1,275 (65.4%)	1,067 (30.9%)	1,869 (40.8%)	4,211 (42.2%)	

499,999-100,000	263 (13.5%)	728 (21.1%)	814 (17.8%)	1,805 (18.1%)	
99,999 - 9,000	283 (14.5%)	767 (22.2%)	996 (21.7%)	2,046 (20.5%)	
Rural/Small town	58 (3.0%)	379 (11.0%)	418 (9.1%)	855 (8.6%)	
Missing	56 (2.9%)	438 (12.7%)	398 (8.7%)	892 (8.9%)	
<b>LHIN of practice address</b>					
1. Erie St. Claire	65 (3.3%)	126 (3.7%)	151 (3.3%)	342 (3.4%)	<.001
2. South West	64 (3.3%)	295 (8.5%)	361 (7.9%)	720 (7.2%)	
3. Waterloo Wellington	12 (0.6%)	292 (8.5%)	245 (5.3%)	549 (5.5%)	
4. Hamilton Niagara Haldimand Brant	157 (8.1%)	356 (10.3%)	401 (8.8%)	914 (9.2%)	
5. Central west	230 (11.8%)	99 (2.9%)	200 (4.4%)	529 (5.3%)	
6. Mississauga Halton	307 (15.7%)	190 (5.5%)	362 (7.9%)	859 (8.6%)	
7. Toronto Central	204 (10.5%)	392 (11.4%)	684 (14.9%)	1,280 (12.8%)	
8. Central	389 (19.9%)	312 (9.0%)	481 (10.5%)	1,182 (11.8%)	
9. Central East	196 (10.1%)	308 (8.9%)	346 (7.6%)	850 (8.5%)	
10. South East	33 (1.7%)	174 (5.0%)	198 (4.3%)	405 (4.1%)	
11. Champlain	187 (9.6%)	465 (13.5%)	563 (12.3%)	1,215 (12.2%)	
12. North Simcoe Muskoka	16 (0.8%)	163 (4.7%)	177 (3.9%)	356 (3.6%)	
13. North East	62 (3.2%)	185 (5.4%)	243 (5.3%)	490 (4.9%)	
14. North West	28 (1.4%)	95 (2.8%)	156 (3.4%)	279 (2.8%)	
Missing	0 (0.0%)	0 (0.0%)	14 (0.3%)	14 (0.1%)	
<b>Previous home-based encounters (Mean ± SD)</b>					
	24.93 ± 45.71	15.30 ± 24.02	27.07 ± 51.44	19.45 ± 35.92	<.001
<b>Previous home-based encounters (Median (IQR))</b>					
	7 (2-24)	7 (2-18)	5 (2-24)	7 (2-20)	0.026
<b>Prevalent conditions, active**</b>					
					<.001
0	1,218 (62.5%)	2,403 (69.6%)	3,187 (69.6%)	6,808 (68.2%)	
1	490 (25.1%)	804 (23.3%)	1,075 (23.5%)	2,369 (23.7%)	
2	170 (8.7%)	200 (5.8%)	244 (5.3%)	614 (6.1%)	
3	50 (2.6%)	37 (1.1%)	60 (1.3%)	147 (1.5%)	
4	16 (0.8%)	<=10 (0.2%)	<=10 (0.2%)	33 (0.3%)	
5+	6 (0.3%)	<=5	<=5	13 (0.1%)	
<b>Prevalent conditions, ever</b>					
					<.001
0	650 (33.3%)	1,174 (34.0%)	1,728 (37.7%)	3,552 (35.6%)	
1	605 (31.0%)	1,128 (32.7%)	1,419 (31.0%)	3,152 (31.6%)	
2	353 (18.1%)	695 (20.1%)	871 (19.0%)	1,919 (19.2%)	
3	201 (10.3%)	303 (8.8%)	371 (8.1%)	875 (8.8%)	
4	94 (4.8%)	116 (3.4%)	139 (3.0%)	349 (3.5%)	
5+	47 (2.4%)	36 (1.0%)	108 (2.4%)	137 (1.4%)	
<b>Size of physician roster (Mean ± SD)</b>					
	1,119.34 ± 925.71	1,113.72 ± 596.16	. ± .	1,115.75 ± 732.34	0.786
<b>Size of physician roster (Median (IQR))</b>					
	952 (423-1,600)	1,063 (744-1,453)	. (-.)	1,032 (666-1,500)	<.001

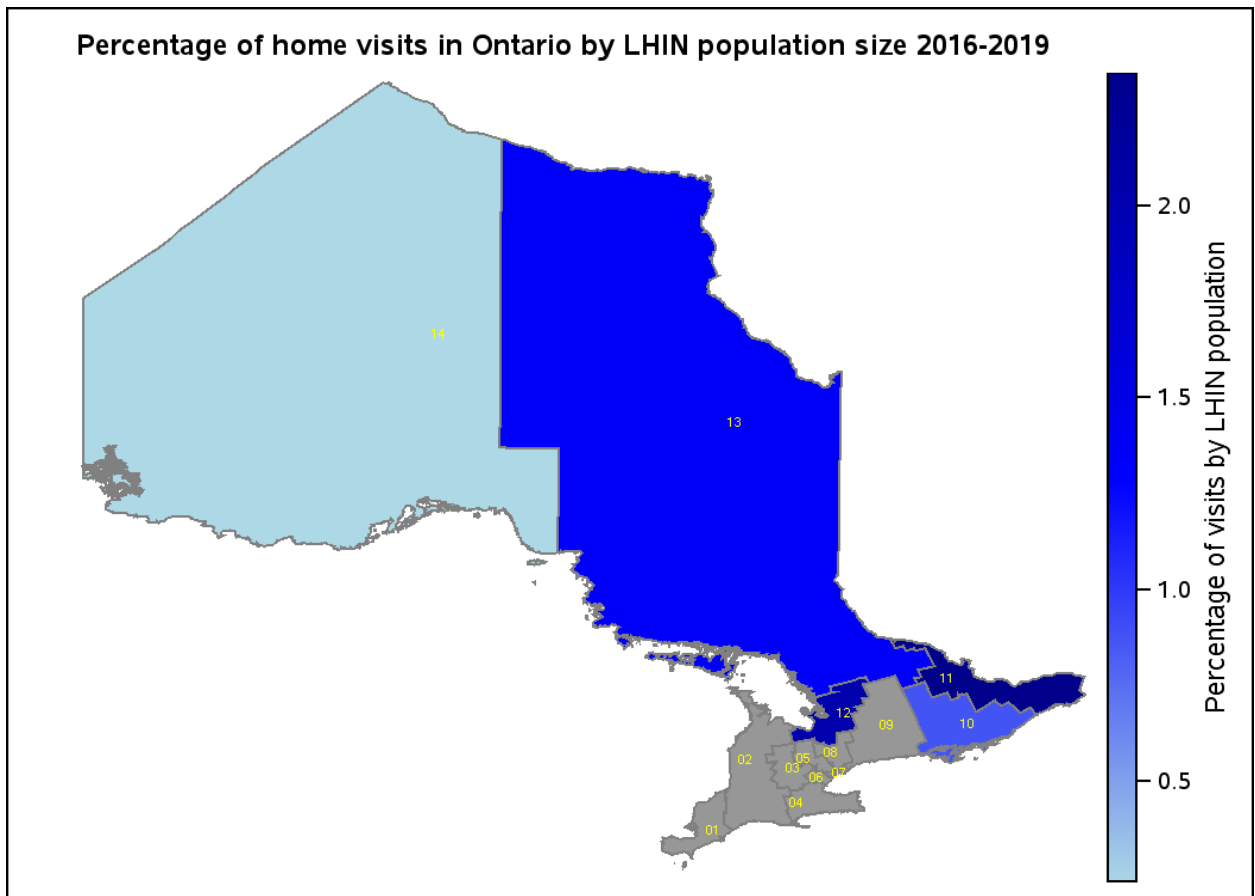
Legend: FFS=Fee-for-service, IQR=Interquartile range, SD=Standard Deviation, CMA=Census Metropolitan Area/CA=Census Agglomeration

\*Palliative care designation calculated from practice billings during the study period (2016-2019)

\*\*Using a lookback window of 2 years from index date

### Regional visit variation

Home visit delivery varies across Ontario's 14 local health integration networks (LHINs) as described in Table 2. There are a number of LHINs with higher proportions of physicians delivering visits than the overall proportion of physicians practicing in that region. Certain LHINs had notably higher proportions of physicians delivering end of life visits from the proportion of primary care physicians practicing in each region, for example 12.0% of physicians delivered visits in a region that contained on 9.2% of the total physician cohort. Figure 5 depicts the variation of home visit delivery across LHINs according to the number of decedents and physicians. The highest rate of end-of-life home visits was 44.47 per 10,000 physicians and the lowest was 4.16 per 10,000 physicians.



*Figure 5. Map of the proportion of home visits delivered by primary care physicians delivered to patients in their last year of life between 2016-2019 by the LHIN population size from 2016*

**Table 4: Tabular format of the rate of end-of-life home visits by primary care physicians to patients in their last year of life in Ontario by the number of decedents and practicing physicians.**

Local Health Integration Network (LHIN)	Number of physicians delivering visits	Number of visits (2016-2019)	Population of the LHIN (2016)	Visits per population
1	342	2458	627633	0.39
2	720	18984	953261	1.99
3	549	4716	766109	0.62
4	914	22428	1399073	1.60
5	529	8357	922255	0.91
6	859	20218	1164740	1.74
7	1280	27742	1232258	2.25
8	1182	15640	1813058	0.86
9	850	6480	1550531	0.42
10	405	4252	482391	0.88
11	1215	30312	1292639	2.34
12	356	9498	464406	2.05
13	490	7405	551801	1.34
14	279	546	228339	0.24

*Regression models*

The adjusted odds of physicians delivering a home visit to patients in their last year of life are presented in Tables 5 and 6. Older age, female, international training, remuneration models with patient enrollment, more home visit experience, and both rural and metropolitan areas with more than 500,000 residents were the six characteristics associated with increased odds ratio [OR] of delivering a home visit in the adjusted logistic regression results.

<b>Table 5: Logistic regression analysis modelling the odds of a physician delivering at least 1 home visit to a patient in their last year of life between 2016-2019 in Ontario without LHIN</b>				
Variable	Adjusted Odds	95% Confidence Intervals		Pr > ChiSq
		Lower	Upper	
Female Sex (ref: male)	1.175	1.007	1.372	0.0044
Increased 1 year in Age (continuous)	1.013	1.004	1.023	0.018
Any home encounters delivered by the physician in previous year	1.015	1.012	1.018	<.0001
International medical grad (N ref)	1.285	1.04	1.588	0.0201

<b>Palliative care designation</b>				
None	Ref	-	-	-
Generalist	0.917	0.73	1.151	0.4534
Specialist	0.213	0.13	0.349	<.0001
<b>Remuneration</b>				
FFS	Ref	-	-	-
Enhanced FFS	1.527	1.169	1.996	0.0019
Mainly Capitation	1.413	1.117	1.789	0.004
<b>CMA Size</b>				
Missing	1.082	0.613	1.91	0.7862
1,250,000+	1.696	1.296	2.22	0.0001
500,000 - 1,249,999	1.836	1.46	2.567	<.0001
100,000 - 499,999	1.419	1.077	1.871	0.013
9,000 - 99,999	Ref	-	-	-
Rural/Small Town	1.382	1.019	1.877	0.0377
<b>Income quintile</b>				
1	1.502	1.111	2.03	0.0081
2	1.125	0.875	1.451	0.3636
3	1.153	0.924	1.438	0.2083
4	1.212	1.005	1.463	0.0444
5	Ref	-	-	-
Previous history of chronic conditions (1+)	0.95	0.892	1.011	0.1057
Previous hospitalizations (ref: none)	1.04	0.865	1.251	0.6743
<b>Emergency department visit (ref: none)</b>	0.978	0.842	1.137	0.7729
<b>Immigrant (ref: no)</b>	0.934	0.743	1.176	0.563

Legend: FFS=Fee-for-service, IQR=Interquartile range, SD=Standard Deviation, CMA=Census Metropolitan Area, ref=reference category.

\*Palliative care designation calculated from practice billings during the study period (2016-2019).

\*\*Using a lookback window of 2 years from index date.

Older age was associated with home visit delivery with a continuous increase in odds ratio [OR] of 1.01 (95% Confidence Interval (CI): 1.00-1.02) for each additional year primary care physicians lived. Having international training increased physician's odds of delivering a visit with an odds ratio of 1.28 (95% CI:1.04-1.59) compared to Canadian-trained physicians. Billing a higher number of visits in the year before the study period was associated with higher odds of delivering visits during the study period (OR 1.02 95% CI: 1.01-1.02). The remuneration model physicians use impacted their odds of delivering a visit with an enhanced fee-for-service model having the highest odds (OR 1.5, 95%CI: 1.17-2.00), followed

closely by a mainly capitation model (OR 1.4 95% CI:1.11-1.79) compared to a traditional fee-for-service model. Physicians living in rural areas or small towns (<9,000 residents) and census metropolitan areas (CMA) with more than 500,000 residents had increased odds of delivering visits, with physicians in rural areas or small towns (<9,000 residents) having 1.38 (95%CI: 1.02-1.88) the odds of delivering a visit, those in a CMA with 1,249,999-500,000 residents having 1.84 (95%CI: 1.46-2.57), and those living in the largest CMA (1,250,000+ residents) having 1.70 (95%CI: 1.30-2.22) the odds of delivering a visit compared to those in smaller CMAs (9,000-99,999 residents).

A second regression model using LHIN, found after adjusting for age, sex, previous home visit delivery, immigrant status, income quintile, history of chronic conditions, emergency department visits, hospitalizations, remuneration, international training, and palliative care designation, physicians practicing within the Toronto Central LHIN had the highest odds of delivering a home visit (OR 1.79, 95%CI: 1.24-2.58) followed closely by those living in the Central LHIN with odds of 1.47 (95%CI: 1.04-2.06) compared to those in the Mississauga Halton LHIN.

**Table 6: Regression analysis modelling the odds of a physician delivering a home visit to a patient in their last year of life between 2016-2019 in Ontario including LHIN**

Variable	Adjusted	95% Confidence Intervals		Pr > ChiSq
	Odds	Lower	Upper	
<b>Age (continuous)</b>	1.013	1.004	1.023	0.0054
<b>Sex (Female ref)</b>	1.165	0.996	1.362	0.557
<b>Income quintile</b>				
1	1.443	1.063	1.959	0.0187
2	1.094	0.846	1.414	0.4934
3	1.132	0.905	1.415	0.2775
4	1.191	0.986	1.415	0.0696
5	Ref	-	-	-
<b>CMA Size</b>				
Missing	1.179	0.659	2.111	0.5788
1,250,000+	1.715	1.019	2.024	0.0422
500,000 - 1,249,999	1.843	1.311	2.593	0.0004
100,000 - 499,999	1.51	1.126	2.044	0.0058
9,000 - 99,999	Ref	-	-	-
Rural/Small Town	1.492	1.088	2.044	0.013
<b>Palliative care designation*</b>				
None	Ref	-	-	-
Generalist	0.922	0.733	1.161	0.4898
Specialist	0.209	0.127	0.344	<.0001
<b>International medical grad (ref: no)</b>				
	1.329	1.072	1.646	0.0093
<b>Emergency department visit (ref: none) **</b>				
	0.984	0.846	1.144	0.8307
<b>Immigrant (ref: no)</b>				
	0.942	0.748	1.187	0.6126
<b>Hospitalization (ref: none) **</b>				
	1.046	0.869	1.144	0.633
<b>Number of encounters in previous year</b>				
	1.015	1.012	1.018	<.0001
<b>Remuneration</b>				
FFS	Ref	-	-	-
Enhanced FFS	1.582	1.206	2.074	0.0009
Mainly Cap	1.398	1.101	1.775	0.0059
<b>LHIN</b>				
1. Erie St. Claire	0.944	0.478	1.863	0.8671
2. South West	1.314	0.731	2.361	0.3617
3. Waterloo Wellington	1.532	0.824	1.863	0.1775

4. Hamilton Niagara Haldimand Brant	1.462	0.808	2.645	0.2097
5. Central west	1.041	0.681	1.592	0.8512
6. Mississauga Halton	Ref	-	-	-
7. Toronto Central	1.788	1.241	2.577	0.0018
8. Central	1.465	1.041	2.062	0.0285
9. Central East	1.371	0.866	2.171	0.178
10. South East	1.247	0.667	2.332	0.4898
11. Champlain	1.44	0.784	2.643	0.2396
12. North Simcoe Muskoka	1.421	0.764	2.646	0.2673
13. North East	1.571	0.431	1.786	0.149
14. North West	0.877	0.431	1.786	0.7172
<b>Previous encounters (continuous 1+) ref: 0</b>	0.944	0.887	1.005	0.0734

*Legend: FFS=Fee-for-service, IQR=Interquartile range, SD=Standard Deviation, CMA=Census Metropolitan Area, ref=reference category*

*\*Palliative care designation calculated from practice billings during the study period (2016-2019)*

*\*\*Using a lookback window of 2 years from index date*

#### 4.4 Discussion

Overall, 25.7% of practicing primary care physicians in Ontario between 2016 and 2019 provided at least 1 home visit to a patient at the end of life. Physician demographic, practice, and health characteristics all were associated with increased home care in the last year of life.

Physician characteristics associated with increased home visit delivery in our results included older age, more years of practice, and practice in a rural location which are congruent with literature on characteristics of physicians delivering home visits.(20, 21, 30) Previous studies found male physicians and those with solo practices were more likely to deliver home visits, although not limited to end-of-life visits. (20, 21, 30, 60) Our results differed; female sex was associated with home visit delivery (OR 1.18 95% CI: 1.01-1.37) and physicians with group practice remuneration had higher odds of delivering visits (OR 1.41 95% CI:1.12-1.79). Most previous studies on home visits included physician specialists – a physician

demographic known to have a higher proportion of males (122) – indicating sex differences between primary care physicians may differ when there is a more balanced ratio of males and females. Furthermore, previous studies were not end-of-life specific, so this may reflect end-of-life care providers are unique. Additional significant novel variables, not previously studied, were health region, remuneration model, international training, physicians’ history of comorbidities, their recent emergency department visits, and palliative care practice. This study was also the first to describe physician’s own health variables such as comorbidities, hospitalizations, emergency department visits, previous and current childbirths for female physicians in association with home visit delivery. Although statistically insignificant after model adjustment, describing these variables is a first step in understanding how physician health may impact practice.

The rate of physician home visits differed across regions (Figure 2). Regional variation in healthcare is documented in many countries and jurisdictions.(111, 123-127) A report from ICES has shown geographical variation in comprehensive care provision across Ontario,(128) which is congruent with our findings that rates of physician home visits differ across local health integration networks. Furthermore, inequities of access to home care services across regions has been previously reported which may influence the supports for end-of-life community care and home visits.(73) There may be value in modelling end-of-life supports after the United Kingdom (UK), where home visits are delivered routinely by a physician or nurse practitioner.(63) However, there is a paucity of evidence on the effectiveness of implementing these models into an established healthcare system.(74) Smith et al. has suggested that the local context determines an ideal healthcare model more effectively than fitting one standard model to different localities.(75) Understanding the demographic and practice characteristics of physicians currently delivering visits in each locality is a first step in developing supports to facilitate more home visits and alleviate the acute care system.

Increasing the number of home visits delivered requires outlining aspects of practice models that enable or encourage physicians to visit end-of-life patients at home.(24, 64) A lack of financial incentives has been suggested as a reason why some physicians do not deliver home visits.(27, 29, 32) Physician's remuneration model may be an important factor in understanding a physician's home visit delivery. Capitation, involving patient enrollment, showed a strong association with home visit delivery, indicating physicians predisposed to visit a patient's home may self-select into a capitation model, or that the model itself enables home visit delivery. The majority of palliative care specialists in Ontario practice as a primary care physician and many are consultants within a hospital setting, explaining why the majority (76.1%) belong to a traditional fee-for-service model and why a specialist designation is associated with a 79% reduction in odds (OR 0.21, 95%CI: 0.13-0.35) of delivering a visit compared to those without a palliative designation. These results highlight the unmet demand for palliative care in the community, further supporting documented need for palliative training and an increase in palliative care generalists.(18, 46, 129-131) Canadian born and Canadian-trained physicians made up 82.6% and 74.7% of the physicians in capitation practice models respectively. An interesting observation is that despite the lower proportion of internationally trained physicians in capitation models (21.3%), international training was associated with home visit delivery. These results highlight a difference in international and Canadian graduate practice patterns, warranting further exploration. It could be since international medical graduates are often required to practice in underserved communities as a return to service program and face more competition for residency programs than Canadian graduates. This may also indicate bias is present in the selection of physicians to join capitation-based practices, with a possible disadvantage for immigrants. Challenges for internationally trained physicians have been described in previous literature.(132-134) The finding that physicians' practice characteristics influence healthcare delivery, for example those belonging to alternative compensation plans having higher odds of delivering end-of-life home visits, is a first step

in unravelling the complex relationship between healthcare delivery and physicians' practice arrangements.

### *Strengths and limitations*

This study has a number of strengths including that it is the first and largest to explore physician's home visit delivery at a population level, it uses observational data instead of self-reported data, corroborates previous research variables, explores novel characteristics, and includes a diverse set of physicians and patients – including internationally trained and immigrant physicians. A limitation of this study is that the data availability was limited to only physicians registered after 1990. Age was right skewed with more younger physicians, suggesting a higher proportion of older physicians were not included in this analysis. Understanding younger physicians' practice patterns and demographics may inform how our healthcare system can better accommodate an aging population. Another limitation is the lack of information on variations of resources and homecare supports within Ontario. Regional resources or supports that may encourage physicians to deliver visits including regional palliative care supports, would merit further investigation. Canada is not ranked in the top ten countries for end-of-life care quality,(34) making this research important to improve end-of-life care practices, yet it highlights gaps in care and how Ontario is not a model example of home-based end-of-care. The results need to be interpreted with caution as they may not be generalizable in all contexts.

### **Conclusions**

This research on primary care physicians delivering home visits to patients in their last of life in Ontario between 2016 and 2019 highlights the small proportion of physicians delivering this service and provides the most comprehensive list of physician characteristics associated with providing this service. This research shows physician demographic and practice characteristics influence the delivery of home visits to patients in their last year of life and demonstrates regional variation exists. Developing healthcare

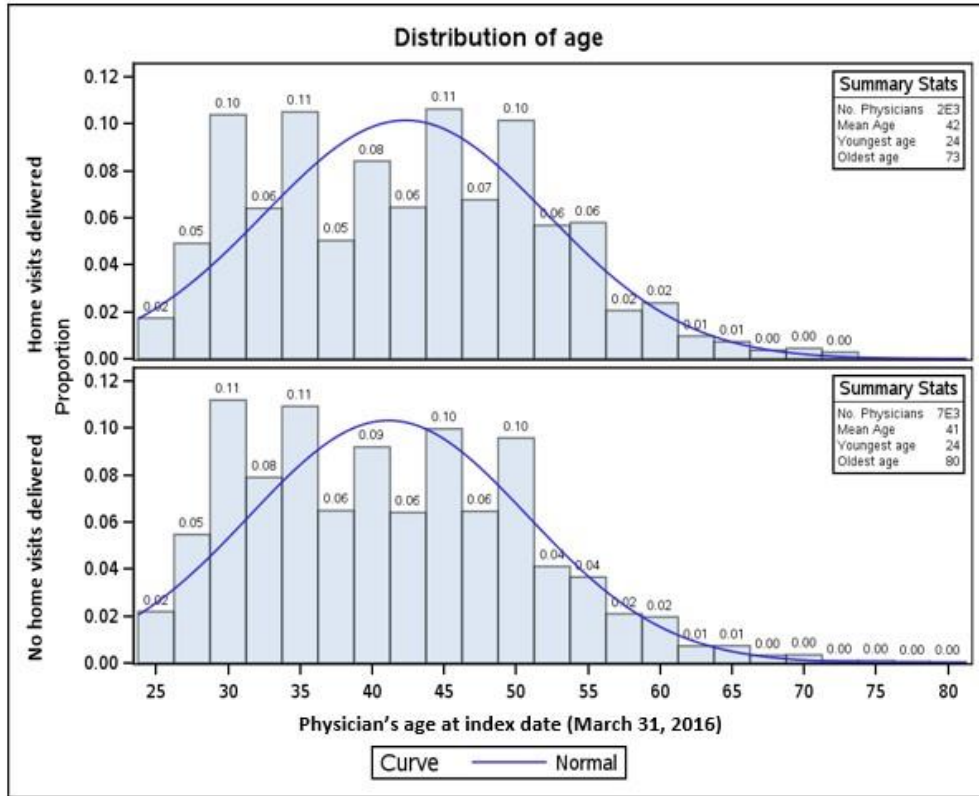
system policy and resources that enable providers to deliver high-quality care by choice may be achieved through identifying modifiable factors associated with increased service provision. Understanding the relationship between physicians' characteristics and home visits could be a preliminary step towards building a healthcare system that accommodates physician's preferences and the preferred care of an aging population at the end of life.

## Chapter 5: Additional results

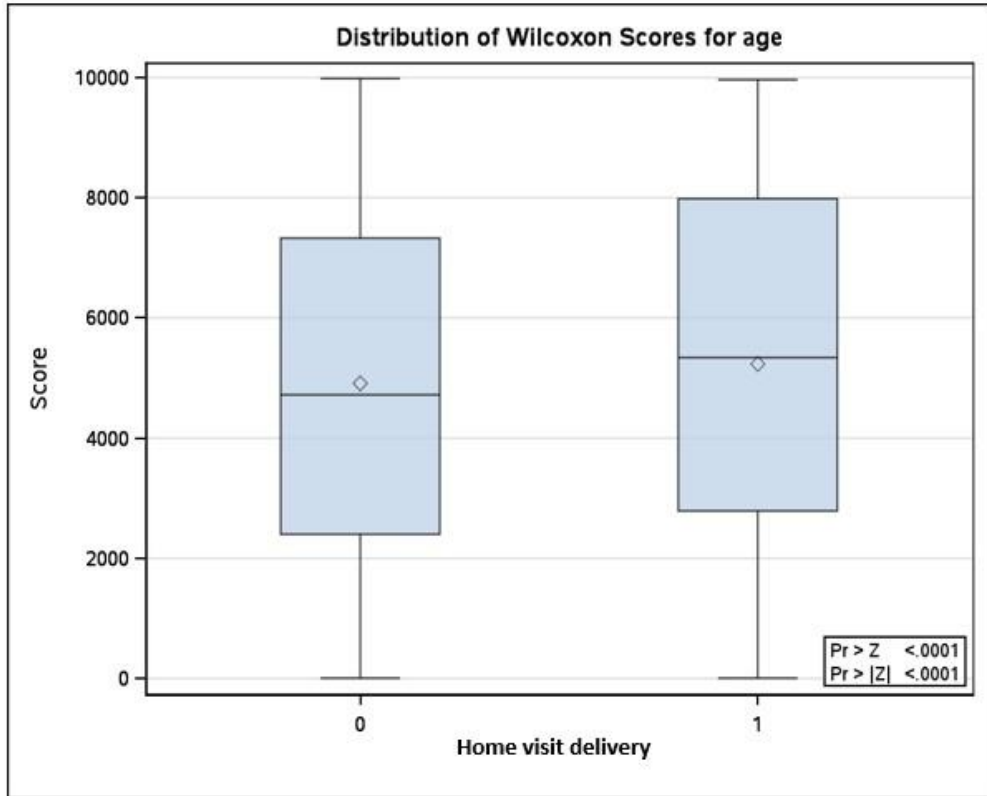
The main results of the analysis are included in Chapter 4 and highlight the main findings. This section describes additional findings and includes some of the key features of the descriptive analysis performed, which informed the regression model building and interpretation.

### *Age*

The distribution of age was right skewed, due to the younger cohort of physicians in the CPSO data (Figure 6). Distribution did not significantly differ between those delivering visits and those not, although a slight shift towards older physicians can be observed in the distribution and this aligned with the hypothesis that older age would be associated with home visit delivery. Due to the abnormal distribution observed in the physicians' age, a Wilcoxon score was calculated (Figure 7) for age by the primary outcome of end-of-life home visit delivery.



**Figure 6: Distribution of primary care physicians' age according to home visit delivery for patients at the end of life between 2016-2019 in Ontario.**



*Figure 7: Distribution of Wilcoxon score for age based on home visit delivery*

Age and sex

Primary care physicians' distribution of age differed by sex. Figure 7 shows the distribution of female physicians' age was higher in the younger ages (up to 12.6% and 13.2% of the cohort being 34 years of age for those that delivered visits and did not, respectively), while the male distribution of age had higher proportions in the older age, most notably 13.1% of male physicians delivering visits were 52 years of age.

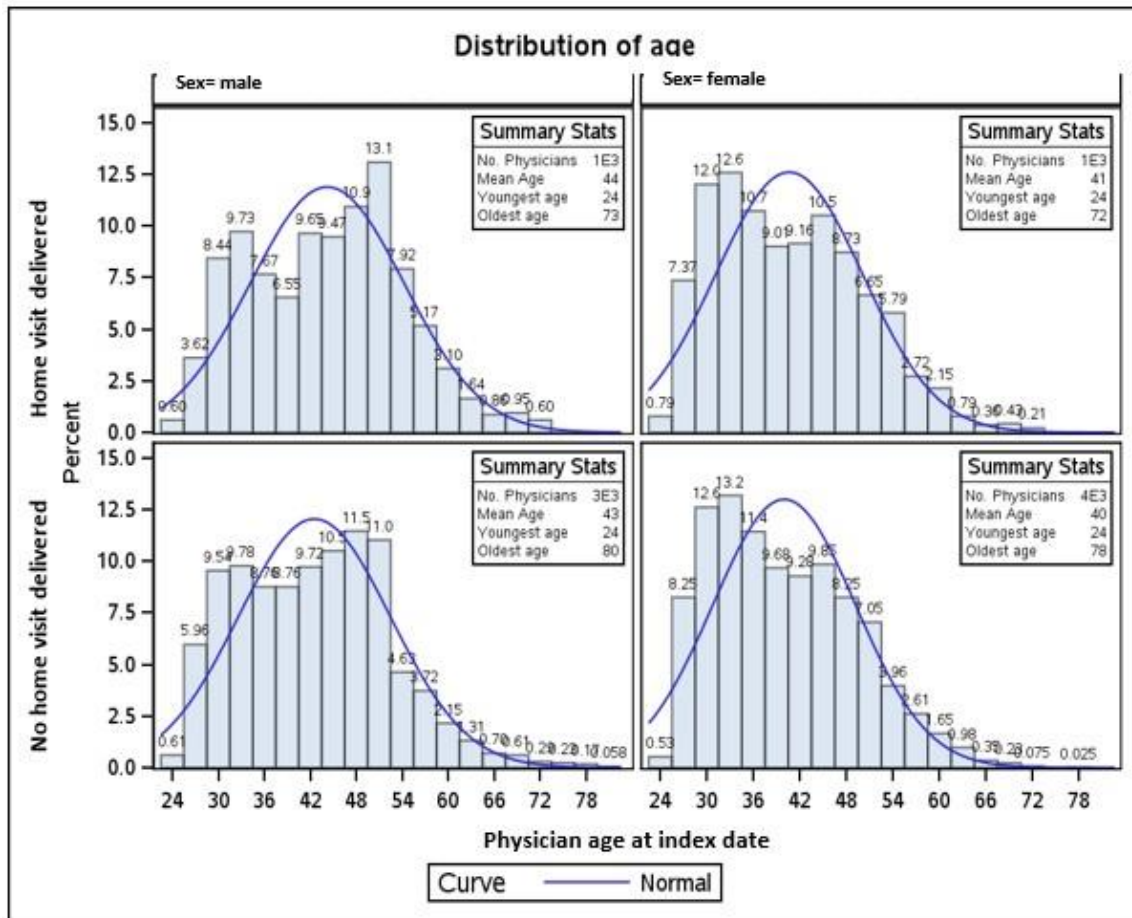
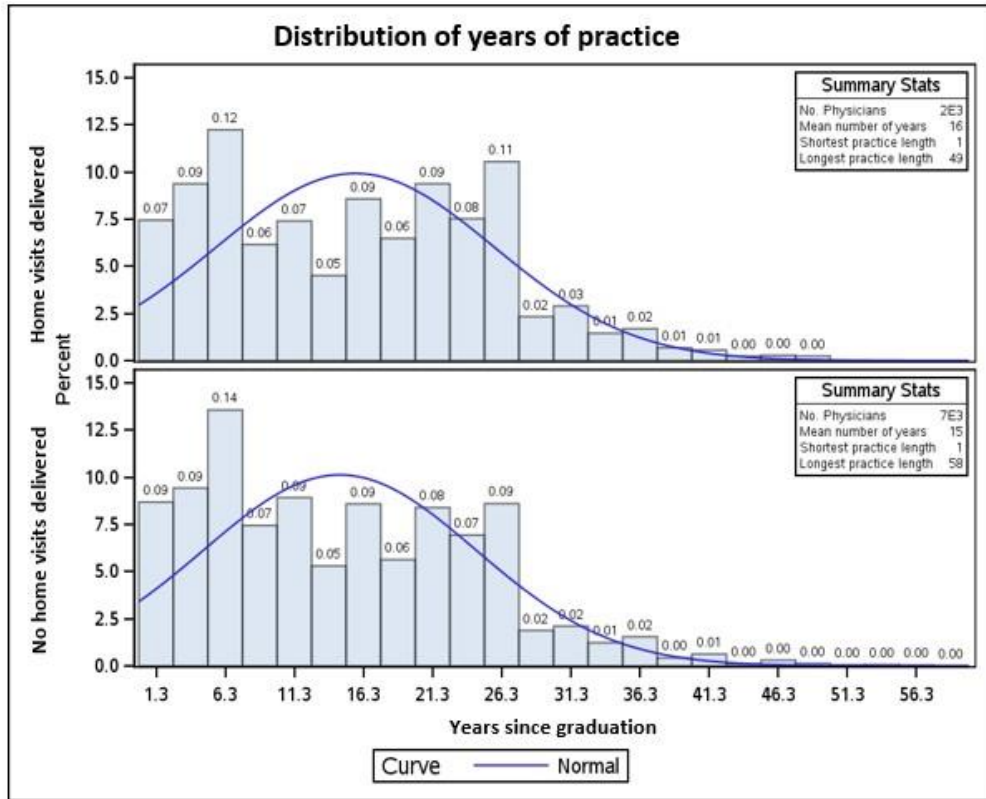


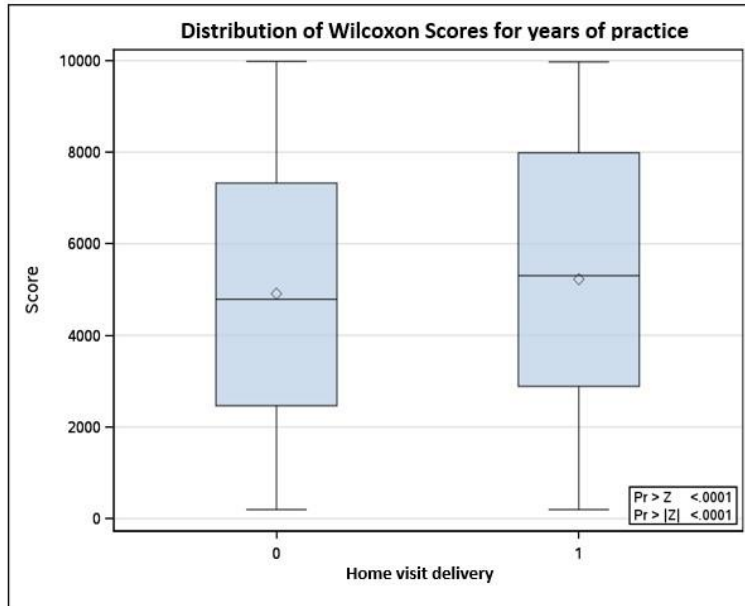
Figure 8: Distribution of primary care physicians' age by sex according to home visit delivery for patients at the end of life between 2016-2019 in Ontario.

*Years of practice since physicians' graduation*

The distribution of years of practice was closely related to age (as expected) and is depicted in Figure 9. Due to the abnormal distribution observed in the physicians' age, a Wilcoxon score was calculated for years of practice by home visit delivery (Figure 10). There was collinearity detected visually between age and years of practice and years of practice was thus excluded from further analysis to prevent interaction.



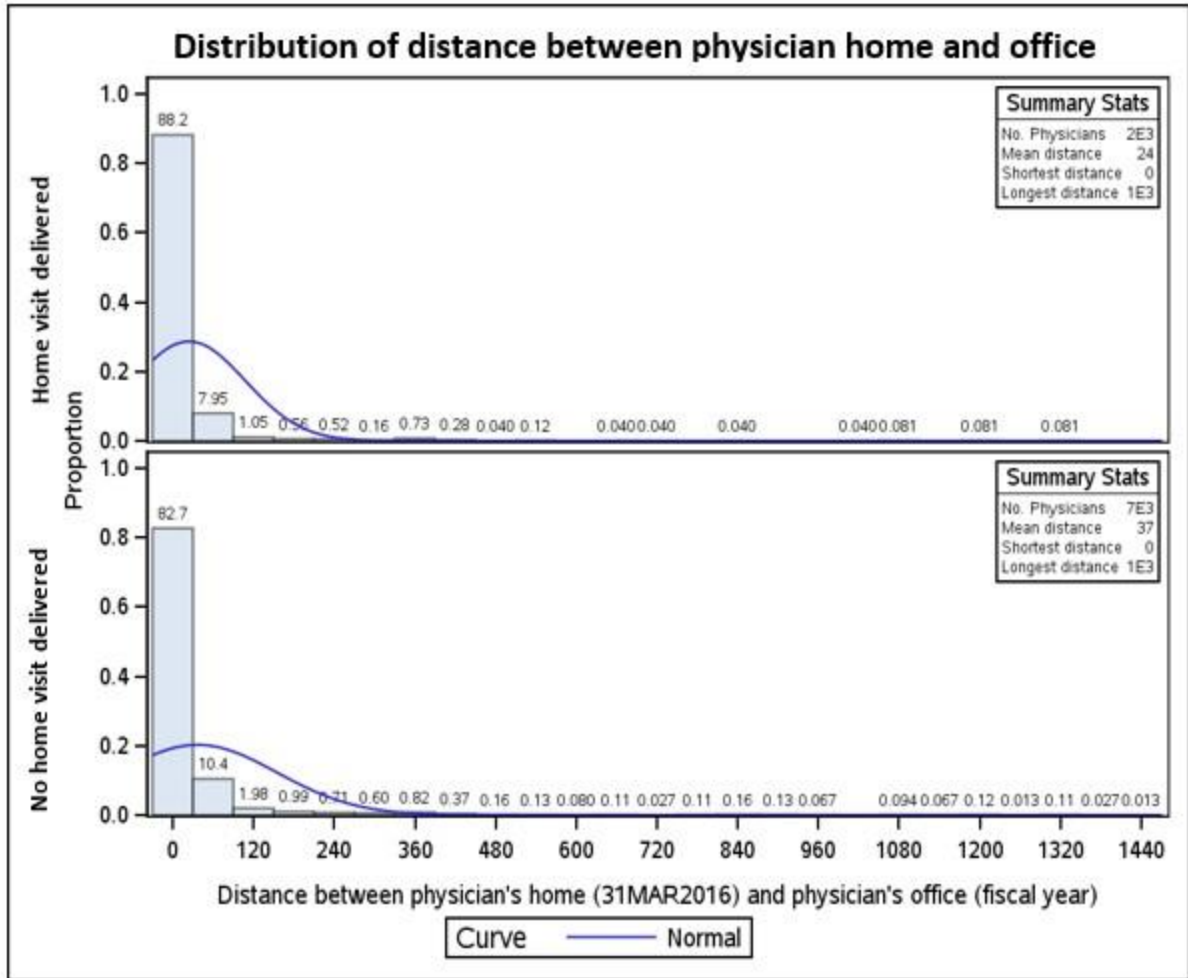
**Figure 9: Distribution of physician's years since graduation according to end-of-life home visit delivery during fiscal years 2016-2019 in Ontario, Canada.**



**Figure 10: Distribution of Wilcoxon score for years of physician practice based on home visit delivery**

*Travel distance – Distance between physician home and office*

Travel distance had a very abnormal distribution and can be observed in Figure 11. As might be expected, there was a high proportion of physicians with low distances. Unfortunately, there was significant variation in distances with a mean of 33.5 kilometers (km) and a standard deviation of 110.7 km (min: 0 km, max: 1411.18 km). See Figure 11 for the distribution of distance according to the primary outcome. The reasons for these differences could be due to improper data record keeping, physicians with more than one practice location, or physicians practicing in a different location than their principal residence (e.g. locums). Developing further methods to measure distance between physicians' home and office locations to their dying patients is a valuable area of study to pursue as regional variation in the provision of comprehensive primary care has been shown in Ontario.<sup>(135)</sup> The number of physicians with large variation in distances suggests the integrity and quality of this variable may be low. After consulting with ICES scientists and a data analyst, this variable was removed from the analysis.



**Figure 11: Distribution of physician’s travel distance between their home and office according to end-of-life home visit delivery during fiscal years 2016-2019 in Ontario, Canada.**

*Immigrant status and international training*

Physicians that were immigrants to Canada made up 19.95% of the cohort and 76.3% of those also had international training. Additionally, 80.1% of immigrants who were also internationally trained, delivered at least one home visit and only 15.8% of non-immigrants who were internationally trained delivered at least one home visit. Having international training had increased odds of delivering a visit. When controlling for immigrant status, the crude odds for delivering a visit was highest for those who were also immigrants with odds of 1.35 (95%CI: 1.03-1.76) compared to Canadian trained physicians and Canadian born, internationally trained physicians had odds of 1.21 (95%CI: 1.03-1.21).

## Chapter 6: Discussion

### Overview

Home visits to patients in their last year of life were delivered by 25.7% of primary care physicians in our cohort of practicing physicians across Ontario between 2016-2019. Just over half (50.1%) of the physicians who delivered visits belonged to a mainly capitation remuneration model, to which 34.6% of the entire cohort of physicians belong. Physician characteristics associated with increased home visit delivery included older age, higher years of practice, and practice in a rural location which is congruent with past literature on characteristics of physicians delivering home visits.(20, 21, 30)

### Home visits and care quality indicators

Healthcare needs and costs are usually highest at the end of life with the majority (59.5%) of Canadians dying in hospital.(22) There is increasing pressure to improve end-of-life healthcare and prevent overloading the acute care system in an aging population.(136, 137) One indicator of high-quality care is patients dying in their preferred location of death,(138, 139) which is not being achieved based on the most recent literature around place of death preference. Home visits have been associated with death at home.(16, 56) While acute care is appropriate for many patients at the end of life, there is evidence that most patients prefer care in their home, (1-6) and that physician home visits improve patient and system-level outcomes.(76)

Based on patient assessment of select indicators (e.g. clinical information systems, interprofessional teams, performance measurement and feedback, and quality improvement support), evaluation of Canadian primary care quality has been consistently weak in comparison to other countries belonging to the Organization for Economic Co-operation and Development (OECD).(140)

### Comparing results to previous literature

#### *Home visit availability*

Our results show home visits by a physician are a limited resource in Ontario. Similar findings were reported in a recent Ontario study, which calculated the rate of primary care physician home visits based

on the proportion of home visits billed per year. The results found no home visits delivered for 30.9% of physician years, meaning home visits were not delivered by any physician for almost a third of the study period.(60) With low rates of home visit delivery, it is difficult to determine the benefits of increasing this service. A recent economic analysis in Ontario found the incremental cost of one death in the community is \$995CAD,(141) accounting for all healthcare costs, including acute care provided to those receiving end-of-life homecare. A higher rate of home visits by physicians could improve healthcare quality and may reduce overall expenditures.(76) Evidence that physician home visits reduce acute care utilization,(12, 13, 59, 60) may indicate these increasing the number of visits can mitigate care costs and enable a preferential place of death.

#### *Physician characteristics*

Previous studies found male physicians with solo practices were more likely to deliver visits. (20, 21, 30) Our results differed, finding sex not significantly associated with home visit delivery and physicians with group practice remuneration had higher odds of delivering visits (OR 1.38 95% CI:1.09-1.75). Most previous studies on home visits included physician specialists – a physician demographic known to have a higher proportion of males(122) – while our results indicate sex differences are less significant between primary care physicians. However, the one Canadian study using a survey-based methods which only included primary care physicians had also found male physicians had higher odds of providing any home visits and a higher number of visits than their female counterparts.(94) There may be regional differences or, as our cohort was younger, sex differences may be less significant in a newer generation of physicians with younger female physicians delivering a higher proportion of visits than their male counterparts (Figure 7). Our study was the first to use a population-based cohort so it also reduces respondent bias that may be present in survey-based study designs.

In this cohort, there was a significant proportion (21.0%) of internationally trained physicians and their odds of home visit delivery was significantly higher (OR 1.34, 95%CI: 1.12-1.61) than their Canadian-

trained counterparts. Physicians who immigrated to Canada during their life did not have a statistically significant association ( $p > 0.05$ ) with delivering visits, suggesting international medical training may better equip physicians for home visiting or may point to differences in internationally trained physicians' preferences or access to particular practice models. A lower proportion of internationally trained physicians (31.2%) belonged to capitation-based remuneration models compared to Canadian graduates (64.1%) and an even larger discrepancy in proportion is found between immigrant physicians (24.3%) and Canadian-born physicians (75.7%). There is significant missing data (20.7%) in the international graduation variable, making this variable less reliable and at risk of bias. These results highlight a difference in international and Canadian graduate practice patterns, warranting further exploration. It could be since international medical graduates are often required to practice in underserved communities (i.e., as 'return of service' for acceptance into residency programs) and face more competition for residency programs than Canadian graduates. This may also indicate bias is present in the selection of physicians to join capitation-based practices, with a possible disadvantage for immigrants. Challenges for internationally trained physicians have been described in previous literature.<sup>(132-134)</sup> This discrepancy is particularly of interest since physicians belonging to patient-enrollment models had increased odds of home visit delivery (OR 1.38 95% CI:1.09-1.75), and less internationally trained physicians belonged to capitation models. Further research on physicians' training in palliative and home care and physicians' entry into Canadian medical systems is warranted to explain the differences between physicians' training, remuneration model section, and immigration status.

#### Novel physician variables

A number of novel variables were included in this study with palliative care designation, local health region across Ontario, physicians' remuneration model, and physicians' own health history including their comorbidities, and previous emergency department visits all having significant associations with home visit delivery. Non-significant novel variables were: active prevalent comorbidities, immigrant status,

recent hospitalizations, recent mental health admissions, and childbirth among female physicians. With home visits being suggested as a high-quality way to deliver care to housebound patients,(24, 72) there is value in understanding why such a small proportion of primary care physicians incorporate home visits into their practice. As it remains an optional practice for physicians, this research may identify modifiable factors that could enable an increase in home visit delivery and non-modifiable factors that require additional supports.

Palliative care is practiced across all settings and most physicians practicing as a consultant within inpatient and hospital settings are registered as a primary care physician. The palliative care designation found 2.5% of the cohort were billing over 10% of their services as palliative codes and were therefore deemed palliative care specialists. Although some community-based physicians may be captured within this category, it is likely that the majority of these specialists are hospital-based consultants. This would explain why a palliative care specialist designation is associated with a 79% reduction in odds (OR 0.21, 95%CI: 0.13-0.34) of delivering a visit compared to a non-palliative designation. These results highlight the need for community palliative care and how care for the dying should not be reserved for specialists, but rather supported by their guidance and expertise. There remains a need for accessible clinical palliative care training as it currently remains as an optional elective in Canadian residency programs.(72, 142, 143)

#### Remuneration

Physician remuneration is tied to the healthcare system model. Literature on physician remuneration models has been developed by economists,(144, 145) policy analysts,(146-148) and health services researchers.(149-151) Canada is unique from many countries as it provides universal healthcare, has a provincial healthcare organization,(152) and underwent a primary care reform between the years 2000 and 2006.(148, 150) Canada's universal health system, introduced in the 1960s, has resulted in a turbulent series of negotiations between healthcare providers and government to determine the terms of care and

compensation.(152) Policy creation in Canadian healthcare is a balancing act between healthcare providers, government fiscal budgets, and patient assessment performance.

There is evidence that remuneration impacts physicians' practice patterns, however next steps to organize remuneration for optimal healthcare remains inconclusive.(147, 149-151) Similarly, the results of this analysis found remuneration impacted physician propensity to deliver home visits. Physicians using an enhanced fee-for-service model having the highest odds (OR 1.5, 95%CI: 1.15-1.96), followed closely by a mainly capitation model (OR 1.38 95% CI:1.09-1.75) compared to a traditional fee-for-service model. There is previous Canadian literature suggesting that models with patient enrollment do have better patient satisfaction, although they provide fewer services.(150) Due to the descriptive design of this study, these results cannot determine remuneration model performance, however these results do align with previous literature on remuneration and may suggest physicians' practice decisions are influenced by model factors.

Developing primary care remuneration models that provide consistent coverage and are flexible enough for regional variation is challenging, particularly in a country such as Canada with vast differences between rural areas and urban centers. For example, in the three northern Territories (Yukon, Northwest Territories, and Nunavut), primary care is often nurse-led.(152) Primary care physicians in Canada have some autonomy in their practice choices, including no rostering enforcement.(152) Similarly, the number of patients rostered to each physician can differ significantly as seen in these results. These may be explained by a variety of reasons, such as academic appointment, which may influence other aspects of the care. For example, they may have more flexibility to deliver home visits. There are restrictions on certain payment models, with limits to the number of physicians practicing within Family Health organizations (FHO). When availability within a FHO opens, physicians can apply and are interviewed by the physicians within an organization. There could be patterns of social networks, bias or discrimination that exists in some office selection processes, limiting access for some physicians or selecting certain

individuals over others. There has been increasing pressure on primary care providers, and there is evidence that many individuals experience burnout.<sup>(153)</sup> Increasing mandated home visits to physicians' practice without restructuring the system would likely be unsustainable and result in negative downstream consequences for both patients and providers.<sup>(153)</sup> Ideally, policy would aim to develop a system that improves patient outcomes and health system performance while also enhancing the physician experience. There are a number of ways to start building this system, including increasing medical trainees' exposure to home visits and palliative care training early in their training to ensure physicians are comfortable and equipped for this service provision. In the UK, physicians are included in system-level decision-making and have been mandated to care for their patients to ensure each patient has a provider. Our results show low rates of physician home visit delivery may be a result of upstream system-level factors (i.e., low rates of end-of-life training or de-incentivized practice remuneration models) and previous literature suggests a lack of these visits may have downstream consequences (i.e. acute care utilization). The finding that physicians' practice characteristics influence healthcare delivery, for example those belonging to alternative compensation plans having higher odds of delivering end-of-life home visits, is a first step in unravelling the complex relationship between healthcare delivery, physicians' practice arrangements and characteristics.

### Strengths and Limitations

This is the first population-level study to describe end-of-life home visits provided by primary care physicians in Ontario and across local health regions. It is also the first study to inspect physicians' own health-related characteristics in association with their delivery of home visits. A limitation of this study is that the data availability was limited to only physicians registered with CPSO after 1990. There was a right skewed distribution of age, suggesting a higher proportion of older physicians were not included in this analysis. Previous research found younger physicians were less likely to deliver home visits. Therefore, understanding younger physicians' practice patterns and demographics may inform how the new

generation of physicians' practices can accommodate an aging population through home visits. Another limitation is the lack of information on variations of resources and homecare supports within Ontario, as it was not routinely collected data and is thus out of scope of this study design. However, if this information could be manually collected and combined with the regional mapping conducted in this study, it would provide a useful understanding of what supports exist and how it impacts home visit rates.

This study does not include information on allied health workers and nurse practitioners who provide significant proportions of care to patients, particularly in community settings. Understanding the support from these other professionals is necessary to understand the extent of care that is provided in the home which may enable patients to remain at home instead of accessing acute care services. Further data and research on the network of professionals that work alongside physicians is required to arrange an optimal healthcare system that supports healthcare professionals in providing appropriate care to patients at the end of life. This study is based on Ontario data, a province in Canada representing approximately 40% of the nation's population, with provincially organized primary care systems. Canada is not ranked in the top ten countries for end-of-life care quality,(34) making this research important to improve end-of-life care practices, yet it highlights gaps in care and how Ontario is not a model example of proper care. The results need to be interpreted with caution as they may not be generalizable in all contexts.

### Conclusion

Physicians home visits at the end-of-life are a scarce resource in Ontario, although they are associated with improvements in both patient outcomes and health system performance. This study was aligned with previous literature showing that physicians' age, previous experience, and specialty are associated with home visit delivery. Novel physician variables including remuneration model, and health-related variables add to the literature and provide further evidence on physician characteristics that enable an expanded practice. Developing healthcare system policy and resources that enable primary care physicians and other healthcare providers to deliver high-quality, end-of-life care may be achieved through identifying

factors associated with increased service provision. Canadian physicians have been afforded significant individual choice in their practice parameters, therefore implementing stricter policy could result in negative outcomes (e.g., increased burnout or litigation) rather than building a healthcare system that increases the quality of life of all citizens. This research also supports efforts to increase palliative care delivery in Ontario and suggests a primary care model that supports generalist palliative care delivery through consultant specialists and a regional network for coordination and care aids. While the results suggest further research and reform is needed, it provides a solid background on the physician characteristics and patterns associated with end-of-life home visit delivery. This research provides descriptive evidence on characteristics of physicians that deliver end-of-life home visits to generate further investigation into physician practice and to guide decision-makers toward areas that encourage and enable provision of high-quality end-of-life care.

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## Appendices

### Appendix I: OHIP billing codes used to determine a home visit delivery (according to the OHIP schedule of benefits 2020)

OHIP codes	Description	Remuneration
A900	Complex house call assessment (frail elderly or housebound patients)	\$45.15 (max 1 per patient)
A901*	House call assessment (usually billed with B997 or B998)	\$45.15 (max 1 per patient)
B960	Travel premium for Special Visits to Patient's Home: Weekdays Daytime (07:00- 17:00) Nonelective OR Elective home visit	\$ 36.40 (max. 2 per time period)
B961	Travel premium for Special Visits to Patient's Home: Weekdays Daytime (07:00- 17:00) with Sacrifice of Office Hours Nonelective	\$36.40 (max. 2 per time period)
B962	Travel premium for Special Visits to Patient's Home: Evenings (17:00- 24:00) Monday through Friday Nonelective	\$36.40 (max. 2 per time period)
B963	Travel premium for Special Visits to Patient's Home: Sat., Sun. and Holidays (07:00- 24:00) Nonelective	\$36.40 (max. 6 per time period)
B964	Travel premium for Special Visits to Patient's Home: Nights (00:00- 07:00) Nonelective	\$36.40 (no max. per time period)
B966	Travel premium-palliative care home visit	\$36.40 (no max. per time period)
B990	Special visit to patient's home, weekday/daytime	\$27.50 (max. 10 per time period)
B992	Special visit to patient's home, weekday/daytime, sacrifice office hours	\$44.00 (max. 10 per time period)
B993	Special Visits to Patient's Home (other than Long-Term Care Institution), weekends and holidays (non-elective)	\$82.50 (max. 20 per time period)
B994	Special visit to patient's home, non-elective, evening hours	\$66.00 (max. 10 per time period)
B996	Special visit to patient's home, night time (first patient)	\$110.00 (no max. per time period)
B998	Special visit to patient's home, palliative care, days, evenings (from 2005)	\$82.50 (no max. per time period)
B986	Travel premium for a geriatric home visit	\$36.40 (no max. per time period)
B987	Geriatric home visit during the night (00:00- 07:00) (first patient)	\$110.00 (no max. per time period)
B988	Geriatric home visit to patient's home on days, evenings, and holidays (07:00-24:00) (first patient)	\$82.50 (no max. per time period)

Legend: OHIP=Ontario Health Insurance Plan,

\*Removed from the Schedule of Benefits – effective October 1, 2019 (154)

Appendix II: Crude rate calculation of the rate of home visits delivered by physicians within Ontario based on number of physicians and decedents in the region during the study period.

$$\text{Visit rate per LHIN} = \frac{\text{Number of home visits}}{\text{Number of decedents} \times \text{number of physicians}} \times \text{number of physicians}$$

Appendix III: ICES Databases description and the associated study variables

ICES Databases	Description	Study variables
Client Agency Program Enrolment (CAPE) Database	CAPE provides information on primary care physicians' care organization and remuneration model. This data was provided by the Ontario Ministry of Health and Long-Term Care (MOHLTC).	Physician remuneration model.
College of Physicians and Surgeons of Ontario (CPSO) Database	The CPSO is a controlled dataset ICES. It includes simple demographics, training, registration, and practice specialty for CPSO members who were initially registered (other than Academic Visitor and Short Duration registration classes) at any time from 1990 or later.	Linked to ICES through IPDB using unique physician registration number
Discharge Abstract Database (DAD)	The DAD includes information on all hospitalizations based on a retrospective chart review including International Classification of Diseases-10 (ICD-10) diagnoses codes (up to 16 diagnoses codes for each discharge record), procedures performed during hospitalization, physician providing care, hospital administrative information, and patients' demographic information.	Recent hospitalizations
ICES Physician Database (IPDB)	An ICES derived database with information on Ontario physicians including demographics, specialty, workload, services provided and location. This dataset is updated annually from OHIP, Corporate Provider Database (CPDB), and the Ontario Physician Human Resource Data Centre (OPHRDC) database.	Physician specialty
The Immigrant, Refugees and Citizenship Canada (IRCC)	IRCC includes immigration application records for individuals who originally landed in Ontario, Canada dating back to 1985. The main variables in this dataset include country of citizenship, level of education, mother tongue, and landing date. New immigrants who landed in Ontario and immediately moved to another province or those who moved	Physician immigration status

	from another province may not be captured in this data.	
Local Health Integration Network (LHIN) data		
ICES derived Delivering Mother and Newborns (MOMBABY)	MOMBABY is an ICES derived dataset capturing the characteristics of deliveries, newborns and mothers in Ontario. It is updated annually and provides information on the hospital treatment records as well as mother and baby demographic information.	Childbirth (female physicians)
National Ambulatory Care Reporting System (NACRS)	The NACRS holds data on visits to healthcare institutions. This includes demographics, the setting visited (e.g. day surgery, emergency department, cancer care unit), and clinical data (e.g. diagnosis, treatment).	Recent emergency department visits for physicians
Ontario Health Insurance Plan (OHIP) Claims Database	The OHIP database holds all billing claims paid for by the Ontario Health Insurance Plan. Each record represents the delivery of a service from a particular physician to a particular patient and includes the date, the fee paid, and the number of times it was billed.	Home visit delivery (primary outcome), billing percentage, palliative care, childbirths (females)
Statistics Canada's Postal Code Conversion File Plus (PCCF+)	This is an ICES derived macro designed to link PCCF files to other census geographic identifiers and was used to create urban/rural flags, neighbourhood income quintiles, dissemination area/enumeration area, census division, and latitude/longitude. This macro is updated according to changes in census data from which it is derived.	Converts postal code from the RPDB to determine: Rurality, Income quintile, Census division, LHIN, population size of practice location
Registered Persons Database (RPDB)	The RPDB holds information on each individual who has ever had an active Ontario health card number. This data was provided by the Ministry of Health and Long-Term Care (MOHLTC). The most relevant information in this dataset are demographic information, geographic information, and eligibility of OHIP coverage.	Physicians' age, sex, postal code, death information (if applicable)