

PHYSICIAN PRACTICE IN CANADIAN LONG-TERM CARE SETTINGS

PHYSICIAN PRACTICE PATTERNS IN CANADIAN LONG-TERM CARE
SETTINGS: DEFINING, MEASURING, AND EVALUATING IMPACT ON CARE
QUALITY

By DARLY DASH, BSc, MSc

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for the Requirements of the Degree of Doctor of Philosophy

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AUTHOR: Darly Dash, BSc, MSc (McMaster University)

SUPERVISOR: Dr. Andrew P. Costa

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Lay Abstract

As Canada's population ages, long-term care homes care for complex residents who require skilled medical care. Family physicians provide this medical care, but their practice patterns vary greatly. Some doctors dedicate most of their practice to long-term care, while others visit only occasionally. There is a research gap in understanding how physician practice impacts the care that long-term care residents receive.

This thesis studied physicians working in long-term care to see how their level of commitment and the long-term care setting affect resident care. Experienced physicians were consulted to determine what defines commitment to long-term care practice that is most relevant and feasible. The research involved analyzing health records, consulting expert physicians across Canada, and examining medication prescribing patterns in long-term care homes. Findings showed some practice differences between committed long-term care physicians, but the relationship with care quality was complex.

Experienced physicians agreed that commitment involves more than the number of residents cared for or the time spent with them. This research suggests that physicians impact the care quality long-term care residents receive, but the relationship is complex. Other factors beyond the individual physician, such as culture, staff, and policies, also impact care quality.

Abstract

Background: Family physicians deliver medical care for long-term care residents in Canada. These physicians provide care with varying levels of commitment, but there are knowledge gaps concerning the relationship between physician practice and care quality. No consensus exists on how to define and measure physician commitment in long-term care.

Objectives: This thesis examined: (1) How does physician commitment to long-term care influence resident care quality? (2) What are the relevant and feasible expectations for physician commitment in long-term care? (3) How does the long-term care practice environment influence medication prescribing patterns?

Methods: This thesis comprised a retrospective cross-sectional study, a modified e-Delphi study, and a retrospective cohort study. Using health administrative data, the commitment of long-term care physicians was described and examined in relation to resident outcomes. Expert physicians rated statements to define expectations of commitment. A multi-level cohort study analyzed electronic medical records of long-term care residents to examine prescribing variation at the resident, unit, home, and organizational levels.

Results: Only 114 (8.3%) physicians had a practice commitment of 80% or higher, which was associated with 10% fewer emergency department visits, but showed inconsistent relationships with other outcomes in administrative data. The consensus study established that commitment is multidimensional, encompassing 21 statements that define commitment. Lastly, this work examined the long-term care practice environment in a multi-level analysis and found substantial prescribing variation across

psychotropic and non-psychotropic medications, with home variation consistently exceeding unit variation.

Conclusion: This thesis provides the first comprehensive understanding of physician practice in Canadian long-term care homes. The studies developed an approach to measure commitment within health administrative data and demonstrated that commitment is multidimensional, with care quality resulting from complex interactions between physician characteristics and organizational contexts. This thesis provides support for evidence-based guidance for medical education, workforce planning, and quality improvement initiatives.

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I dedicate this work to my parents.

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List of Abbreviations

Abbreviation	Definition
AASM	American Academy of Sleep Medicine
ACCORD	ACcurate COnsensus Reporting Document
ACOVE	Assessing Care of Vulnerable Elders
ADL	Activities of Daily Living
ATC	Anatomical Therapeutic Chemicals
BPSD	Behavioural and Psychological Symptoms of Dementia
CAC	Certificate of Added Competence
CCRS-LTC	Continuing Care Reporting System – Long-Term Care
CCSMH	Canadian Coalition for Seniors' Mental Health
CI	Confidence Interval
CME	Continuing Medical Education
CNS	Central Nervous System
COE	Care of the Elderly
CrI	Credible Interval
CVD	Cardiovascular Disease
ED	Emergency Department
EMR	Electronic Medical Record
FP/GP	Family Physician/General Practitioner
FTE	Full-Time Equivalent
HiREB	Hamilton Integrated Research Ethics Board
ICC	Intraclass Correlation Coefficient
ICES	Institute for Clinical Evaluative Sciences
IQR	Interquartile Range
LTC	Long-Term Care
MDS	Minimum Data Set
MOR	Median Odds Ratio
MPLTC	My Practice in Long-Term Care
MRP	Most Responsible Physician
NH	Nursing Home
OHIP	Ontario Health Insurance Plan

OnSPARK	Ontario Supporting Partnerships to Advance Care and Knowledge
OR	Odds Ratio
PCP	Primary Care Physician
PHIPA	Personal Health Information Protection Act
RAI-MDS	Resident Assessment Instrument – Minimum Data Set
RECORD	REporting of studies Conducted using Observational Routinely collected health Data
REDCap	Research Electronic Data Capture
RIW	Resource Intensity Weights
RR	Rate Ratio
SD	Standard Deviation
SNF	Skilled Nursing Facility
SNFist	Skilled Nursing Home Physician
SSRIs	Selective Serotonin Reuptake Inhibitors
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology

Declaration of Academic Achievement

I, Daryl Dash, was responsible for the conceptualization, analysis, interpretation, writing, and revisions of all chapters comprising this thesis. The chapters include an introduction (Chapter 1), a retrospective cross-sectional study (Chapter 2), a consensus study (Chapters 3 and 4), a retrospective cohort study (Chapter 5), and a discussion (Chapter 6). I consulted with my PhD supervisor (Dr. Andrew Costa), thesis committee members (Drs. Henry Siu and Aaron Jones), and mentors (Drs. Paul Katz and Nathan Stall) when methodological and contextual guidance was warranted.

For the retrospective cross-sectional study, I utilized administrative data obtained from ICES. Original data were cut, extracted, and analyzed by an ICES analyst (Mr. David Kirkwood) in accordance with standard ICES procedures for data access, data use, and data sharing. In the consensus study, I recruited the assistance of a medical student (Ms. Maya Potter) and graduate students (Ms. Rebecca Correia, PhD and Mr. Gary Yeung, MD) to assist with questionnaire development and testing before they were disseminated to panel members. Chapter 5 utilized electronic medical record (EMR) data obtained from ONSpark, hosted at McMaster University. In accordance with data access procedures, original data were extracted and analyzed by the Data Manager (Mr. Ahmad Rahim). Before submitting the included studies to academic journals, I collaborated with field leaders and methodological experts to review and contribute to the final drafts, including Mr. Bahram Rahman, Mses. Dee Tripp and Samantha Peck, and Drs. Peter Tanuseputro, Benoit Robert, Patrick Quail, Lisa McCarthy, Paula Rochon, Rachel Savage, Andrea Moser, Rhonda Collins, Sidney Feldman, David Kaplan, Sophiya Benjamin, Jeffrey Poss, and George Heckman.

CHAPTER ONE

Introduction

Long-term care (LTC) and the aging landscape

Long-term care (LTC) encompasses a range of services designed to meet the personal care and health needs of individuals who are no longer able to care for themselves and cannot be adequately cared for at home or in community settings. LTC is typically delivered in designated LTC homes or facilities (also known as ‘nursing homes’ (NHs)) with trained healthcare professionals who provide 24/7 continuous care and support.^{1–3} Services include comprehensive medical, nursing, and personal care; therapeutic and support services; assistance with activities of daily living; medication and treatment administration; meals and housekeeping; and social and recreational programs.² LTC is unique among the other continuum of healthcare services, as many residents who live in LTC homes often reside there until the end of their lives due to significant healthcare needs.

This care environment is facing unprecedented pressures for rapid growth, as Canada and many other countries worldwide are experiencing rapid demographic changes.⁴ According to the 2021 census, 19% of Canadians are older adults aged 65 and older, with over 7.8 million Canadians aged 65+ as of July 2024.^{5,6} Most significant is the growth in the “oldest old” population, those aged 85 and above, as this group is expected to triple in size by 2046.⁷ This older adult population segment, and particularly the oldest old, drives the demand for LTC, given significant health-related issues with multiple comorbid conditions.^{7–9}

Meeting the growing demand is particularly challenging given that modern LTC residents of today present with increasingly complex care needs, characterized by multiple chronic conditions, extensive use of prescription medications, and high levels of frailty,^{8,10} all of which require careful and thoughtful medical care. This complexity has shifted the focus from a traditional curative medical model common in primary care to an approach that balances treatment and management with comfort and quality of life considerations.

Consequently, the complexity of the frail, older adult resident population has elevated the importance of high-quality medical care within LTC homes. Unlike community-dwelling older adults, LTC residents require ongoing, regular medical oversight for multiple chronic and acute health concerns, including management of treatment and care plans, complex medication management, rapid response to changing health needs, sensitive discussions about goals of care and end-of-life preferences, and coordination of care across health care settings, clinicians, and caregivers.^{11–13} The residential nature of LTC requires clinicians who understand this unique environment and can integrate medical care with nursing, personal support services, and work with interprofessional teams to coordinate comprehensive care plans that support residents' overall well-being and quality of life. However, despite the importance of medical care in LTC settings, little is known about who practices in this setting and the influences on the quality of care residents receive. To understand how medical care quality can be optimized in this complex environment, it is essential to examine who provides this care and how they engage with LTC practice.

The role of physicians in LTC resident care

In the Canadian medical practice setting, LTC has traditionally been considered a core component of family medicine practice, rather than a distinct specialty.^{14,15} This makes it unlike specialized medical disciplines, which have defined training pathways and competency requirements. The approach suggests that physicians in LTC practice bring diverse backgrounds, knowledge bases, and skill sets to care for the complex LTC population. Other specialists, such as geriatricians or geriatric psychiatrists, may be consulted for complex cases, but they do not typically provide day-to-day medical care for LTC residents.¹⁶

Regular family physicians deliver the majority of LTC medical care, with varying levels of interest, expertise, and dedication to this practice setting. These family physicians play important roles, such as attending physician and/or medical director for the LTC home, and receive broad training from family medicine residency programs, including primary care, emergency care, home and long-term care, hospital care, and maternal and newborn care.^{15,17} In Ontario, Canada's most populous province, 1,527 physicians were the most responsible providers for LTC residents in 2017, a number that has grown more than twofold in a decade, and of these physicians, almost all (97%) were family physicians.^{11,18} However, family practice training does not mandate minimum practice hours or training standards specific to the LTC population, leading to potential variability in clinician competencies in caring for LTC residents due to differences in medical school curricula and elective rotation selections.¹⁹ Family physicians also engage in ongoing education and continuing medical education (CME) to maintain their licenses, which may include varying degrees of LTC-related content depending on the individual physician's selection and interest.^{20,21}

Some family physicians pursue enhanced skills training programs to obtain Certificates of Added Competence (CACs) in specific areas of family medicine.^{15,17} Two such areas are Care of the Elderly (COE) and Palliative Care CACs, which provide formal recognition for physicians who develop specialized expertise in caring for older adults and managing end-of-life care. In another pathway, family physicians may also apply for a Focused Practice billing designation in COE or Palliative Care, allowing physicians to bill for services relevant to their area of focused practice.²² Both CACs and Focused Practice pathways are highly relevant to LTC practice and acknowledge the skills required for older adults with complex care needs, but these additional designations cannot be identified in existing health administrative databases.²³

Canadian physicians working in LTC have high heterogeneity in their practice patterns. Some dedicate their entire careers to LTC practice, while others view LTC as a peripheral aspect of their broader family practice. Some physicians develop extensive experience and expertise in managing the unique concerns of the frail, older adult LTC resident, while others may deliver more sporadic care or with less specialized knowledge. However, how these differences in physicians' practice patterns impact resident outcomes remains largely unknown, representing a significant gap in our understanding of LTC medical care quality. The diversity in physician backgrounds and engagement reflects broader variations in how medical care is organized and delivered across LTC settings.

Medical care models in LTC

In Canada, there were 2,076 LTC homes in 2021 with diversity in the organization, governance, and delivery of LTC services.^{24,25} LTC is considered an

extended healthcare service meaning that accommodation and personal care services are not covered by the Canada Health Act, resulting in decentralized services with responsibility in delivery and funding remaining with each province and territory.^{25–27} While publicly funded, many LTC residents face out-of-pocket expenses, creating a mixed public-private funding model.^{10,27} However, medically necessary physician services remain covered under the Canada Health Act.^{25,26}

This decentralized approach extends to medical care delivery, with significant variation across Canada in medical coverage models, fee schedules, and incentive structures for LTC physician practice. Some jurisdictions have enhanced fee schedules for visits to LTC, some have alternate payment models such as capitation, bundle payments, and value-based payments, while others maintain standard fee-for-service structures.^{28,29} LTC homes also engage physicians in different ways, ranging from a single physician caring for all residents within a home, to several physicians caring for smaller numbers of residents within a home, to community-based models where community family physicians follow their patients as they transition to be LTC residents.^{29–33}

While the Canadian LTC medical model relies on family physicians, there is a diversity in medical care models internationally. Similar to Canada, general practitioners in Australia and the United Kingdom deliver medical care in LTC (known as residential aged care facilities and care homes, respectively) while receiving limited training in this setting.^{34–37} In contrast, medical care in the United States is primarily delivered by internal medicine specialists and family physicians, with smaller proportions of geriatricians, general practitioners, and physical medicine and rehabilitation

specialists.³⁸ Similar concerns exist about a lack of formal training in the LTC setting and geriatric care principles.³⁹ The U.S. has also seen growth in other advanced practitioners (i.e., nurse practitioners and physician assistants) practicing in LTC.^{40–42} The diversity in the U.S. reflects different regulations and market approaches to LTC medical care. In stark contrast to these generalist approaches, only in the Netherlands is there a ‘true’ specialist approach where physicians complete a specialized three-year training program to practice in nursing home medicine.^{43–46} These specialists are known as elderly care physicians who focus their entire practice exclusively on LTC and have developed competencies specifically in this residential setting to manage complex medical conditions in frail, older adults. However, to date, there remains little evidence linking the specialization to improved quality outcomes.

While the diverse international models demonstrate different approaches to LTC medical care, common challenges exist across systems that affect the quality and consistency of care delivery.

Challenges in LTC Medical Care

There are concerns regarding medical care in LTC, both in Canada and internationally. Several systemic factors have contributed to the relative lack of attention to those delivering medical care in LTC settings. These include implicit ageism that translates into reduced interest in LTC practice, the misconception that LTC care requires less skill since residents have limited life expectancy, and the positioning of LTC at the bottom of the healthcare hierarchy.^{47–52} Additionally, reimbursement for LTC services often lags behind other care settings, while family physicians, who deliver the bulk of LTC services, already face challenges with recognition compared to other

specialties.^{47–49,52–56} These factors compound to create an environment where physician practice in LTC has received insufficient research attention despite its critical importance. In Canada, the COVID-19 pandemic intensified concerns in the LTC sector, including a shortage of medical care clinicians, and those delivering care experienced stress, exhaustion, fear, burnout, and changes to their medical practice.^{29,57–60}

Workforce concerns are not unique to Canada, as many countries worldwide are experiencing a shortage of health human resources, increasing demand due to complexity, high levels of stress and burnout, and the impending retirement of many physicians.^{4,61–73} These concerns suggest that recruiting and retaining physicians to work in LTC is challenging, and may contribute to issues with care quality and access to care, as the LTC setting is characterized by medical care complexity, is time-intensive, and operates under intense regulatory oversight and documentation standards.

Additionally, many physicians do not receive training specific to LTC during their medical education, which may make them less prepared in this practice setting. Only when physicians are available in LTC can high-quality medical care be delivered. This can lead to a decrease in the risk of poor outcomes, such as unnecessary emergency department visits and hospitalizations, and improve satisfaction among LTC residents and family caregivers, who may otherwise perceive care as insufficient or inaccessible.^{32,74–81}

It comes as no surprise, then, that there is growing attention and recognition of the need for quality and consistency in medical care in LTC, including the creation of standards for medical care, calls for the establishment of a specialized “nursing home physician,” and the development of formal competence in this setting.^{35,45,46,68,82–85}

However, significant questions remain about how physician engagement in LTC practice influences the quality of care residents receive. The challenges in medical care delivery and workforce concerns underscore the need for frameworks that can guide the development of more effective physician practice models in LTC settings.

A conceptual framework for physicians in LTC: the nursing home specialist model

One promising framework is the nursing home specialist or ‘SNFist’ model, which refers to clinicians who primarily practice in nursing homes or skilled nursing facilities (SNFs), originating from the United States context.^{42,86,87} This valuable framework offers a means to understand physician practice in LTC and identify factors that contribute to effective physician practice and quality in this setting. The model identifies three dimensions that may contribute to a skilled physician in the LTC setting: commitment, competence, and medical staff organization.^{42,87}

Commitment refers to the degree to which a physician dedicates their medical practice, attention, and professional identity to LTC practice. This may include a proportion of their practice devoted to LTC, as well as other elements such as engagement with residents, staff, the care environment, and a dedication to serving the LTC resident population.^{39,42,87}

Competence encompasses the knowledge, skills, training, expertise and experience relevant to caring for residents in LTC settings.⁴² This includes understanding geriatric medicine principles, medication management in complex populations, a palliative approach to care, and familiarity with the long-term care continuum environment.⁸⁷

Medical staff organization represents the structural and procedural elements that govern the organization and delivery of medical care within LTC homes, including consideration of medical staffing models, care coordination processes, and integration with interprofessional care teams.^{42,87} A structured, “closed” model, restricting to a smaller number of providers, is considered more beneficial for resident clinical outcomes.⁴²

The nursing home specialist model suggests that these three dimensions work together to influence the quality of care delivered to LTC residents. Physicians who demonstrate greater commitment and competence, working within a well-organized medical staff structure, are theorized to provide higher quality care and achieve better care outcomes, and thereby function as nursing home specialists. While this framework provides a useful conceptual foundation, there are remaining gaps in defining, measuring, and evaluating these dimensions in the Canadian LTC context. Given the interest in understanding the role and contributions of LTC physicians, this thesis focuses on commitment for several reasons. First, commitment is theoretically modifiable through policy interventions, practice organization, and professional development, unlike competence, which requires extensive training, or medical staff organization, which involves complex institutional changes. Second, commitment can be measured using existing data sources, enabling population-level investigation. Finally, commitment represents the foundation upon which competence can be effectively applied and the medical staff organization can function optimally.

Physician commitment in LTC

In the LTC setting, commitment has been conceptualized as the degree to which physicians invest themselves in this practice setting, the number of LTC residents under their care, and the time spent, which may influence both the quantity and quality of care provided.⁴² Given the multidimensional nature of the concept, it may also encompass other behavioural dimensions, such as continuity of care and on-site presence in LTC homes.³⁹

A common approach to measuring one aspect of commitment has been to quantify the proportion of medical practice devoted to LTC residents, using billings and health services data. Studies utilizing this approach have found that clinicians who primarily practice in LTC contribute to higher-quality care outcomes, including fewer hospitalizations and transfers, and lower use of medical therapies.^{88–92} Other aspects of commitment are less studied, with individual studies examining on-site presence, physician availability, the involvement of fewer physicians in resident care, or assigned dedicated LTC physicians, and have also found improved care quality and communication patterns.^{32,77–79,93}

Despite this existing evidence, our understanding of physician commitment remains limited, with the operationalization of commitment varying across studies and settings, and methodologically diverse studies originating outside the Canadian context, which limits the ability to compare findings and develop a consistent understanding of the impact of physician commitment on resident care quality. Additionally, there is a lack of consensus on expectations of commitment, making it difficult to evaluate the relationship between commitment and resident quality of care outcomes or to develop interventions that may enhance physician commitment in LTC practice. Establishing a

relationship of commitment with measurable resident outcomes is essential for advancing both theory and practice in LTC medical care.

The Need for Outcome-Based Evidence

While the theoretical importance of the nursing home specialist model is clear, demonstrating its impact requires examining specific, measurable outcomes that reflect the quality of medical care LTC residents receive, rather than the broader quality of care outcomes. Existing and commonly used quality indicators, such as the MDS quality indicators, are often multifactorial in nature and while still important to measure, they do not necessarily address the role of the physician.^{42,94,95} The complexity of LTC residents, with their multiple chronic conditions, and the consideration of which outcomes are most relevant to an LTC physician's medical practice, make certain outcomes particularly suitable for evaluating the effectiveness of physician practice patterns.

Seminal work by Saliba and colleagues has developed medical care provider-centric quality measures, known as the Assessing Care of Vulnerable Elders (ACOVE) indicators, although concerns have been raised regarding their feasibility and measurement.^{96–98} More recent work has attempted to develop a core set of quality measures with an international expert panel, and created methods to abstract data to measure physician performance, which has become more feasible with the emergence of electronic medical record (EMR) systems in LTC homes.^{13,99} The 95 quality measures attributed to a physician's influence span seven care domains: cognition, affect, and behaviour; falls, mobility, and pressure ulcers; pain management; urinary continence; medication management; communication and coordination of care; and

goals of care and palliative care.¹³ These physician-specific measures represent an important advancement in the methodological literature that defines the contribution of physicians in the LTC setting. Additional work is needed to understand which physician-specific measures are feasible to measure and most sensitive to differences in physician commitment and practice patterns, while aligning them with data sources.

Existing and traditional measures are also important to measure alongside physician-specific measures. Medication management represents an important quality measure in LTC settings, given the high prevalence of polypharmacy and potential for medication-related harm in frail, older LTC populations.^{100–106} LTC residents typically receive multiple medications for ongoing management of chronic conditions, and for emerging conditions and palliative care needs, that are prescribed by physicians. The use of these prescriptions, particularly for psychotropic medications which are known to have adverse health effects in older populations, reflects the quality of medical decision-making and care planning.^{95,107–119}

Health service utilization patterns, including emergency department (ED) visits and hospitalizations, complement medication prescribing as important physician-sensitive outcomes, although not entirely determined by physician practice. They provide important indicators of care quality and resource use at the health system level. While some acute care use is necessary or inevitable in the LTC resident population, unnecessary transfers may indicate gaps in on-site medical care, poor care coordination, or inadequate management of chronic conditions. However, given the multiple factors that can influence transfer rates, establishing a direct association between physician practices and ED/hospital transfers remains challenging.

Understanding the impact of the nursing home specialist model requires recognizing that quality in LTC is not solely dependent on physician practice, but is influenced by many complex interacting factors operating across the LTC practice environment, including the resident, unit, home, and organization.⁹⁵ Resident-level factors include individual characteristics, care preferences, and clinical complexity. Unit-level factors encompass the immediate care environment, including the assigned physician, care team and their dynamics, continuity of care, unit culture, and daily care routines. Home-level factors include policies, home size, profit status, location, the organization of medical staff within a home, and the overall facility culture. Organizational-level factors (for multi-site operations) include organizational policies, resource allocation and access, and quality improvement systems. Using the perspective of the practice environment is particularly important for understanding medication prescribing patterns, where variation may reflect not only individual physician decision-making, but also organizational cultures, staffing patterns, and systematic approaches to care, all factors that may moderate or mediate the relationship between physician commitment and resident outcomes.

Figure 1 presents the broader conceptual framework on physician practice in LTC and the impact on care quality that underlies this thesis. The framework integrates the nursing home specialist model with the practice environment that influences care delivery in LTC and the outcome-based measures that may reflect physician-sensitive care processes. This comprehensive framework recognizes that physician practice occurs within a complex practice environment and that evaluating physician impact requires attention to specific, measurable outcomes, including physician-specific

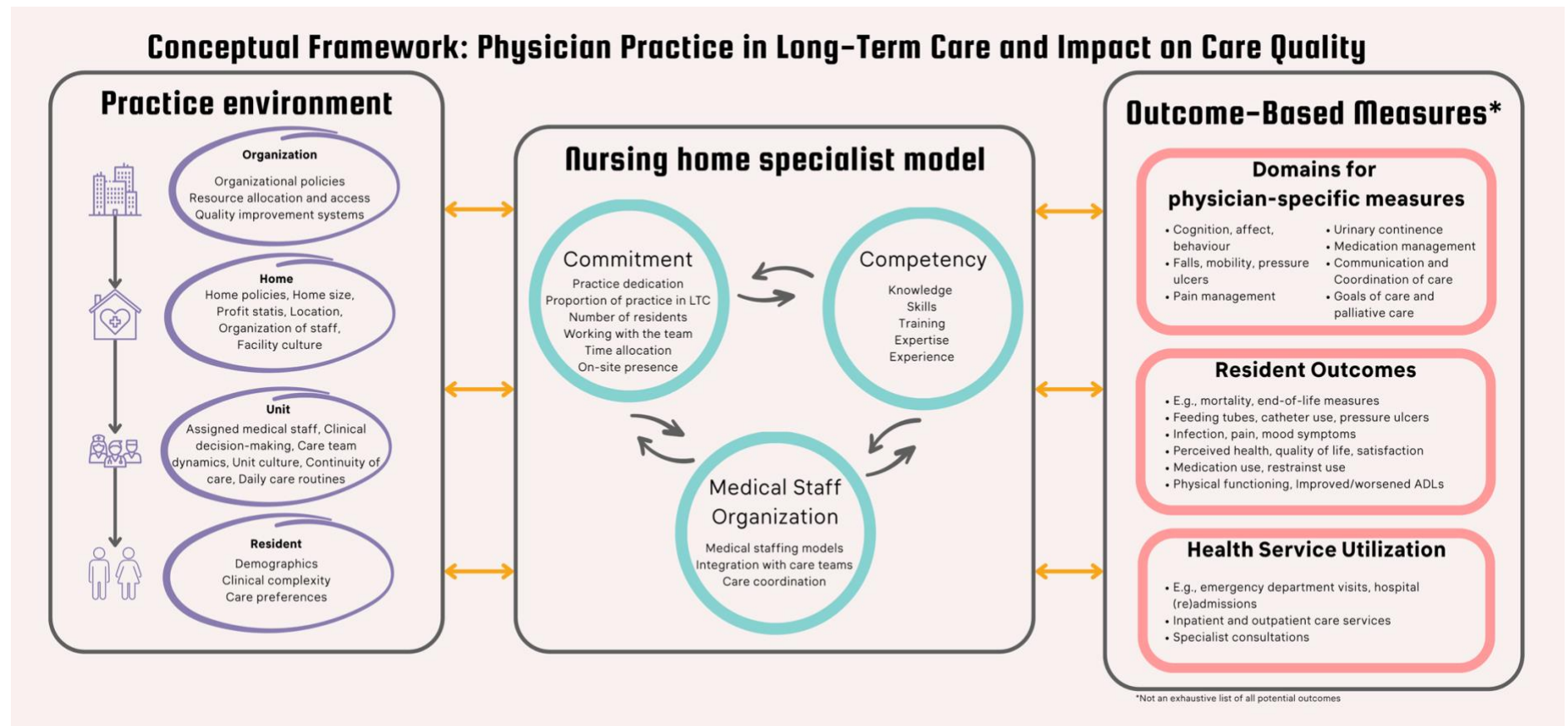


Figure 1. Conceptual framework of LTC physician practice and care quality

measures, resident-based outcomes, and health service utilization metrics. The interconnected nature of the nursing home specialist dimensions reflects the theoretical premise that commitment, competence, and medical staff organization work synergistically to influence care quality, and hypothetically, that physician practice, the practice environment, and care quality can influence one another.

Research gaps and thesis rationale

The literature review reveals several gaps that limit our understanding of medical care in Canadian LTC settings:

1. ***Gap between theory and measurement:*** The nursing home specialist model provides conceptual guidance, but practical approaches to defining, measuring, and evaluating commitment in the Canadian context are lacking.
2. ***Limited evidence on commitment's impact:*** While commitment is theoretically important, there is insufficient evidence about its relationship with resident outcomes in the Canadian context.
3. ***Lack of consensus on physician commitment:*** Without agreed-upon expectations, it is impossible to evaluate commitment meaningfully rooted in LTC medical practice, consistently, or to develop targeted interventions.
4. ***Limited understanding of practice environment interactions:*** Complex interactions occur across the LTC practice environment, but these relationships are poorly understood, including their impact on medical practices such as medication prescribing.

Therefore, this thesis addresses current research gaps by evaluating the relationship between commitment and resident outcomes, establishing consensus-

based expectations of physician commitment, and examining how the practice environment in LTC influences medical care quality. This thesis focuses on several outcome measures, including prescribed medications, health service utilization, and mortality. Addressing these gaps using multi-method approaches is essential for developing evidence-based approaches to improving medical care in LTC and outcomes for this vulnerable population. Figure 2 presents the adapted conceptual framework on physician practice and impact on care quality by highlighting the focus areas examined in this thesis.

Data Sources

This thesis involves the collection and analysis of primary and secondary data sources. Multiple methods were used, and the results from each study informed the planning and conduct of subsequent research stages. The primary data in this thesis included two questionnaires completed by an expert panel in a modified e-Delphi study (Chapters 3 and 4). The study data were both quantitative and qualitative, and were managed using Research Electronic Data Capture (REDCap), hosted at McMaster University.^{120,121} The collection and use of this data received ethical approval from the Hamilton Integrated Research Ethics Board (HiREB; reference # 17321). The secondary data sources examined in Chapter 2 consisted of multiple, population-based health administrative datasets linked using unique encoded identifiers. ICES is an independent, non-profit research institute whose legal status under Ontario's health information privacy law allows for the collection and analysis of health care and demographic data for evaluation and improvement without consent. The use of the data in this study was authorized under section 45 of Ontario's Personal Health Information

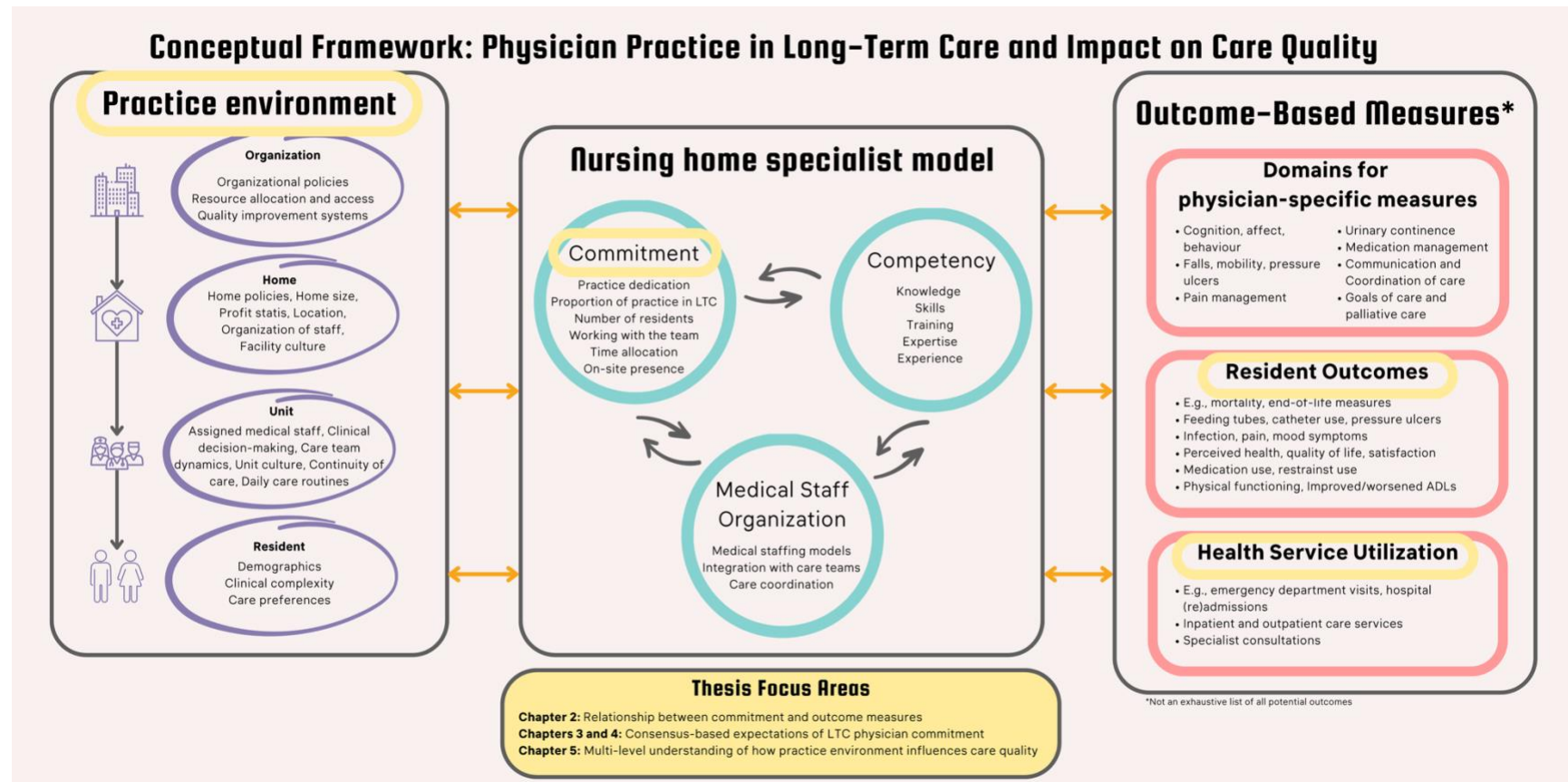


Figure 2. Adapted framework for thesis focus areas

Protection Act (PHIPA) and did not require review by a research ethics board.

Secondary data were accessed and analyzed using the Remote Access Environment at ICES McMaster. Lastly, the secondary data source examined in Chapter 5 consisted of an EMR dataset of residents living in LTC homes across Ontario, Canada. These data were accessed through OnSPARK (Ontario Supporting Partnerships to Advance Care and Knowledge), a secure data platform hosted by McMaster University. This project was reviewed and approved by HiREB (reference #17783).

Thesis Objectives and Approach

This thesis aimed to address research gaps through three interconnected studies that build towards a more comprehensive understanding of physicians with medical practices in Ontario LTC homes and the impact on the quality of medical care delivered to LTC residents. The objectives are:

1. To examine the commitment of LTC physicians in delivering quality care to LTC residents and its influence on outcomes;
2. To establish consensus on relevant and feasible expectations for primary care physician commitment in Canadian LTC homes; and
3. To understand how the practice environment (LTC resident, unit, home, and organization) influences medication prescribing in LTC residents.

Together, these objectives create a comprehensive approach to understanding physician commitment in LTC: measuring it with available data, defining it through expert consensus, and contextualizing it within broader organizational influences on care quality. This integrated approach addresses the limitations of previous research by

combining quantitative analysis of practice patterns with consensus-based expectations and multi-level practice environment analysis.

This thesis advanced methodological literature and epidemiological understanding of LTC physician commitment by developing a novel approach to quantify commitment leveraged through administrative data sources. A baseline understanding of practice patterns and relationship with resident outcomes was established, focusing on medication prescribing and health service utilization. This approach can be adapted and conducted in administrative data sources elsewhere to understand the contributions of LTC physicians to resident outcomes. Furthermore, this work introduced a framework for expectations of LTC physician commitment beyond administrative data holdings. While this multidimensional framework of commitment was data agnostic, it provides a comprehensive and detailed understanding that can be utilized to guide future measurement and evaluation efforts. This thesis also extends current knowledge on prescribing patterns in LTC across multiple medication classes, a concern due to adverse health effects and safety issues, and assesses multiple levels of influence beyond individual physicians to understand how it affects care quality. The findings from this thesis are informative to healthcare professionals, LTC homes, LTC administrators and operators, health care systems and planners, and medical educators who are working tirelessly to improve LTC resident care and working conditions.

This sandwich thesis includes a retrospective cross-sectional study, a modified e-Delphi consensus study, and a retrospective cohort study. The reporting of the observational studies followed the Strengthening the Reporting of Observational

Studies in Epidemiology (STROBE) or REporting of studies Conducted using Observational Routinely collected health Data (RECORD) statements, while the consensus study followed the ACcurate COnsensus Reporting Document (ACCORD) guideline.^{122–124}

Thesis Overview

Chapter 2 presents findings of a retrospective cross-sectional study entitled, “Defining and Evaluating the Impact of Physician Commitment to Nursing Home Practice: A Population-Level Cross-Sectional Study”.¹²⁵ This study was published in the *Journal of the American Geriatrics Society (JAGS)*. I developed an approach to quantifying LTC physician commitment using health administrative data, while consulting expert physicians on real-life practice scenarios, and described practice characteristics as a function of commitment. I then spent considerable effort selecting outcomes to examine in association with LTC physician commitment. This study provided important context for the work behind Chapters 3 and 4, where I engaged expert panellists to define expectations of commitment, without the constraint of administrative data holdings.

Chapters 3 and 4 contain a modified e-Delphi consensus study, in which I established a consensus framework on LTC physician commitment, based on relevance and feasibility. Chapter 3 encloses the study protocol entitled, “Establishing primary care physician commitment in Canadian long-term care homes: a protocol for a modified e-Delphi study”, which was published in the *British Medical Journal (BMJ) Open*.¹²⁶ Chapter 4 exhibits the findings, “A Framework for Expectations of Physician Commitment in Long-Term Care Homes: A Consensus Statement.” I secured an expert

panel of LTC physicians across Canada to rate statements related to LTC physician commitment in two questionnaires, and brought everyone together virtually to come to a consensus on the included items in the framework. As of the submission date for this thesis, the study results are under review with the Journal of the American Medical Directors Association (JAMDA).

Chapter 5 describes a retrospective cohort study entitled, “Variation in Psychotropic & Non-Psychotropic Prescribing in Nursing Homes: A Multi-Level EMR-Based Retrospective Cohort Study”. This work recognizes that physicians practicing in LTC do not work in isolation to impact resident care, and there is the practice environment beyond the physician that impacts medication prescribing behaviour. I evaluated prescribing variation for antipsychotics, antidepressants, cardiovascular disease (CVD) medications, statins, and trazodone across LTC units, homes and organizations. This study contributes new knowledge about unit-level prescribing variation where physicians and the care team work, and uses a novel EMR data repository to evaluate outcomes. At the time of thesis submission, this study is under review with *JAGS*.

Chapter 6 summarizes the findings and implications of the studies in this sandwich thesis. I compare and contrast the insights to previous literature and theoretical frameworks, and discuss the novelty and contributions of this research. A detailed review of the methodological strengths and limitations is also provided.

Conclusions

Despite the critical importance of medical care in LTC settings and the growing complexity of resident needs, our understanding of how physician practice patterns

influence medical care quality remains limited. Theoretical frameworks, such as the nursing home specialist model, offer valuable conceptual guidance, but significant gaps persist in defining, measuring, and evaluating physician commitment within the Canadian LTC context, as well as in understanding the complex practice environment that influences care delivery in LTC settings. This thesis uses a multi-method approach to make several novel contributions: it develops and validates new approaches to measuring physician commitment using administrative data; it establishes the first consensus-based framework for physician commitment in Canadian LTC through expert panel engagement; and provides new evidence on how the practice environment influences medication prescribing patterns across the LTC practice environment. Together, the chapters in this thesis create a more complete understanding of physician practice and its impact on care quality. The findings from this thesis have important implications for healthcare professionals, LTC homes, LTC administrators and operators, health system planners, and medical educators working to improve care quality in LTC. Ultimately, this work contributes to the evidence base needed to develop more effective medical care models that can better serve the growing population of complex, frail residents in Canadian LTC homes.

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CHAPTER TWO

Defining and Evaluating the Impact of Physician Commitment to Nursing Home

Practice: A Population-level Cross-Sectional Study

Summary

This chapter presents the first population-level study to quantify physician commitment to LTC practice in Ontario, Canada and examine its association with resident outcomes. I developed a novel approach to measure physician commitment using health administrative data, creating three measures: the proportion of practice devoted to LTC, years of LTC practice experience, and the number of LTC homes served by physicians. This methodological innovation enables systematic evaluation of physician practice patterns across an entire healthcare system and can be replicated and adapted for use in other jurisdictions with similar administrative data.

While this study found that higher commitment was associated with reduced emergency department visits, the relationships between commitment measures and other resident outcomes were inconsistent and complex. These mixed findings highlighted the limitations of administrative measures in capturing physician engagement and demonstrated that commitment alone may not determine care quality. The study validates that physician commitment alone is insufficient to explain variations in care quality and that administrative measures inadequately capture the complexity of commitment, providing compelling justification for the consensus-based work in Chapters 3 and 4. The recognition that practice environment influences outcomes further supports the multi-level analysis presented in Chapter 5.

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CLINICAL INVESTIGATION OPEN ACCESS

Defining and Evaluating the Impact of Physician Commitment to Nursing Home Practice: A Population-Level Cross-Sectional Study

Darfy Dash¹ | David Kirkwood² | Henry Yu-Hin Siu³ | Paul R. Katz^{4,5} | Aaron T. Jones¹ | Bahram Rahman^{1,6} | Nathan M. Stall^{7,8,9} | Peter Tanuseputro¹⁰ | Benoît Robert^{11,12,13} | Andrew P. Costa^{1,2,14}

¹Department of Health Research Methods, Evidence, and Impact, McMaster University, Hamilton, Ontario, Canada | ²ICES McMaster, Hamilton, Ontario, Canada | ³Department of Family Medicine, McMaster University, Hamilton, Ontario, Canada | ⁴Department of Medicine, McMaster University, Hamilton, Ontario, Canada | ⁵Department of Geriatrics, Florida State University College of Medicine, Tallahassee, Florida, USA | ⁶Physician and Provider Services Division, Ministry of Health, Toronto, Ontario, Canada | ⁷Division of General Internal Medicine and Geriatrics, Sinai Health and the University Health Network, Toronto, Ontario, Canada | ⁸Women's Age Lab and Women's College Research Institute, Women's College Hospital, Toronto, Ontario, Canada | ⁹Department of Medicine, University of Toronto, Toronto, Ontario, Canada | ¹⁰Department of Family Medicine and Primary Care, Faculty of Medicine, University of Hong Kong, Ap Lei Chau, Hong Kong, China | ¹¹Perley Health, Ottawa, Ontario, Canada | ¹²Department of Family Medicine, University of Ottawa, Ottawa, Ontario, Canada | ¹³Ontario Long-Term Care Clinicians, Oshawa, Ontario, Canada | ¹⁴Centre for Integrated Care, St Joseph's Health System, Hamilton, Ontario, Canada

Correspondence: Darfy Dash (dashd@mcmaster.ca)

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ABSTRACT

Background: Medical care of complex nursing home (NH) residents in Canada is primarily managed by physicians. While physician commitment to NH practice is assumed to impact care quality, its influence on resident outcomes is inconsistent. This study quantifies commitment among NH physicians in Ontario, Canada, and its association with the quality of care among NH residents.

Methods: We conducted a retrospective cross-sectional study using multiple linked health administrative databases in 2022. We describe the practice patterns of the most responsible physician (MRP) of NH residents. We assessed three measures of commitment, including the proportion of NH practice based on residents, years in NH practice, and the number of NHs a physician worked in. Pearson-scaled Poisson and negative binomial regression models examined the relationship between commitment and resident outcomes, including medication prescriptions, emergency department (ED) visits, hospitalizations, and death.

Results: Our study identified 1368 NH MRPs practicing in 628 NHs and caring for 84,914 residents in Ontario. One hundred and fourteen (8.3%) had a $\geq 80\%$ practice commitment to NH. The MRP cohort was generally male, had less than full-time practice, worked in more urban settings, and practiced in various settings beyond NH. We observed mixed associations between measures of commitment and resident outcomes, with some evidence suggesting that higher commitment could be beneficial. Residents receiving care from an MRP with $\geq 80\%$ practice commitment had a reduced rate of ED visits (RR 0.90; 95% CI 0.83–0.99).

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Conclusions: Our work is the first to explore the impact of commitment in NH MRPs on resident care quality in Ontario, Canada. While commitment may be a factor, it is not the sole determinant of care quality. Further research is needed to refine how commitment is defined and measured and to consider additional factors beyond the physician, such as infrastructure, NH staff, and team collaboration, in how they influence care quality.

1 | Introduction

Nursing homes (NHs) play a critical role in the healthcare continuum, providing care for frail, medically complex residents, most of whom are older adults. In Canada, family physicians deliver most medical care in NHs to long-stay residents, as Canadian NHs do not focus on postacute care [1]. The practice arrangement of these physicians is variable, from a full-time physician in NHs to those who may spend 1 day or less per week [2].

NH experts have identified a framework linking the practice of all physicians with quality of care, highlighting three features of skilled NH physicians (often referred to as “SNFists”): (1) commitment to NH practice, (2) practice competency, and (3) the organizational structure of medical staff [3, 4]. Commitment is a multi-dimensional concept, and while there is no standard definition, it generally refers to a physician's level of involvement in NH care including the proportion of their medical practice dedicated to NHs, the number of residents cared for, and the time spent [4, 5]. The proportion of NH billings for NH care is already a supported concept of commitment in the literature [1, 6].

Higher physician commitment may improve care quality as physicians may be more likely to meet the complex needs of NH residents, similar to evidence from other settings where specialization and volume enhance outcomes [7–9]. Yet, over-extended physicians (e.g., caring for many NH residents and/or in many NHs) or those spread too thin across multiple settings (e.g., community care, acute care settings, etc.) may struggle to deliver consistent, high-quality care. Our previous work shows a small group of physicians provided care for most NH residents in Ontario, Canada [1]. Other studies quantify different aspects of commitment, such as availability of physicians, being present on-site, or when fewer physicians are involved in resident care per NH, and demonstrate that increased commitment is associated with better care for NH residents [10–14]. However, most of this evidence comes from Europe or the United States, with different care delivery models. There are limited Canadian data evaluating medical care models in NHs to inform policy.

This study examined the association between NH physician commitment and resident outcomes in Canada. We define and measure commitment through administrative data, including the proportion of NH practice, years of practice in NHs, and the number of NHs a physician works in. We hypothesized that greater physician commitment would lead to better outcomes among residents, including reduced prescribing of antibiotics, antipsychotics, benzodiazepines, central nervous system (CNS)-active, and statin medications, and fewer emergency department

(ED) visits and hospital admissions. Given that most NH residents are complex and at the end stages of life, we hypothesized no relationship between physician commitment and all-cause death among NH residents.

2 | Methods

2.1 | Study Design and Setting

We conducted a retrospective, population-level, cross-sectional study of most responsible physicians (MRPs) in NHs from January 1 to December 31, 2022. MRPs are primary care providers responsible for routine assessments and overall care of NH residents. This study was set in Ontario, Canada's most populous province, where physicians provide medical care to residents receiving 24-h personal and nursing care, with subsidized accommodation under the publicly funded NH program. This study adhered to the STROBE and RECORD reporting guidelines [15, 16].

2.2 | Data Sources

We created our cohort using cleaned data from 12 health administrative databases from ICES (formerly the Institute for Clinical Evaluative Sciences), linked via unique encoded identifiers. ICES is an independent, non-profit research institute whose legal status under Ontario's health information privacy law allows for the collection and analysis of health care and demographic data for evaluation and improvement. The use of the data in this project is authorized under section 45 of Ontario's Personal Health Information Protection Act (PHIPA) and does not require review by a Research Ethics Board. Only authorized users are provided access to databases in a restricted environment. Detailed data sources are provided in Data S1.

2.3 | Study Population

We classified a cohort of MRPs who billed through the Ontario Health Insurance Plan (OHIP) for at least one NH resident who received one or more quarterly Resident Assessment Instrument-Minimum Data Set 2.0 (RAI-MDS 2.0) assessments. The classification of MRPs using NH billing models has been previously described in detail [1, 17]. MRPs were excluded if they were not a family physician/general practitioner or did not use monthly management fees or fee-for-service NH billing models. Nurse practitioners were excluded due to our limited ability to identify MRP roles using billing records. Figure S1 illustrates the selection process.

Summary

- Key points
 - There is significant variation in nursing home (NH) physician commitment, and some measures of NH physician commitment are associated with the resident quality-of-care outcomes.
 - While higher commitment is associated with reduced emergency department visits for NH residents, this association is inconsistently observed across other quality-of-care outcomes.
 - Measuring NH physician commitment is challenging as no single factor captures its role in care quality, suggesting the need for a more comprehensive measure that considers presence, workload, experience, and team-based care models.
- Why does this paper matter?
 - This study represents the first population-level study assessing the complexity of physician commitment in nursing homes and its association with resident quality of care.
 - It underscores the importance of a more nuanced approach to evaluating physician dedication and engagement and focusing on interdisciplinary collaboration and resident-centered outcomes to measure and improve quality of care in nursing homes.

2.3.1 | Attribution of Residents and Patients to MRPs

NH residents were attributed to MRPs based on physician services received between quarterly RAI-MDS 2.0 assessments (Figure S1). Residents were excluded if no MRP was assigned to them or if more than one MRP was assigned. Non-NH patients in the primary care setting were attributed to MRPs using billing and patient enrollment records to understand caseload outside NHs [18].

2.4 | Exposure: Physician Commitment Variables

We defined three measures of physician commitment using health administrative data:

1. *NH Practice Commitment.* The proportion of an MRP's patients who are NH residents, calculated as $(N_{\text{residents}} / N_{\text{all patients}}) \times 100\%$. Other versions of this measure were considered, all of which were highly inter-correlated (Table S1). We chose the simplest version of this measure for ease of interpretation. This measure was categorized into quintiles for descriptive purposes and used continuously in regression models when reporting adjusted rate ratios. We report results for every 1% and 10% increase in NH practice commitment.
2. *Years of practice in NH.* The total years an MRP has been practicing in NHs using billing data dating back to 1991, with a minimum of one service record per quarter year. We present the average of this measure descriptively and analyze this measure in 5-year increments in regression models.
3. *Number of NHs.* The number of NHs where an MRP billed OHIP, categorized as one, two, or three or more NHs.

2.5 | Outcome Variables

We selected primary and secondary outcomes based on previous literature, quality improvement projects on physician practice, and expert consultation [19–21]. Primary outcomes were indicators adapted from the Ontario MyPractice in Long-Term Care (MPLTC) report, which were co-designed and reported to clinicians for relevance to medical practice and for quality improvement in NHs. Detailed methodology of the MPLTC reports is available online [22]. These included the prescription of antibiotics, antipsychotics, benzodiazepines, and three or more CNS-active medications. We examined several secondary outcomes, including statins prescribed, which are not part of the MPLTC reports and are not known to be influenced by any quality improvement reporting in Ontario NHs, serving as a negative control; hospital admissions; ED visits; and all-cause death of residents. Outcome definitions are detailed in Data S2. Residents were followed for the outcome until discharge/death or December 31, 2022 (whichever came first).

2.6 | Covariates of Interest

We examined MRP characteristics such as age, sex, years in practice, average distance to NH practice (kilometers), practice rurality (urban/rural), location of medical training (Canadian/International), and full-time equivalent (FTE) status. Practice patterns in both NH and primary care settings were examined. For NHs, we identified the number of NH residents cared for, billing patterns, and referral practices. In primary care, we considered the number of patients cared for and billed for, billing patterns, and the proportion of practice made up of office, hospital, emergency, home, and all other visits based on the location of the physician service rendered. Medical complexity was accounted for using the Canadian Institute for Health Information's Population Grouper Methodology Resource Intensity Weights (RIW) for case-mix classification. RIWs are estimated based on the predicted cost of an individual's health profile, and we included both unadjusted and adjusted numbers [23, 24].

2.7 | Statistical Analyses

Continuous variables were summarized as means, and categorical variables as frequencies and proportions. We used multivariable regression models with the NH MRP as the unit of analysis, and the exposure was the three measures of commitment. We fit Pearson-scaled Poisson models for antipsychotic prescriptions (accounting for underdispersion) and negative binomial regression for all other outcomes (accounting for overdispersion). Models were fit using a log link function and an offset term (see Data S2 for details) to obtain the rate ratio (RR). We produced unadjusted and adjusted estimates. All adjusted models estimated RRs for physician commitment, sex, rurality, training location, FTE status, and NH billing model.

In sensitivity analysis, we included only MRPs with at least 20 residents to capture meaningful practice in the setting [19]. Additionally, we examined a threshold of 80% practice commitment, aligning with literature from the United States defining "SNFists" ($\geq 80\%$ billings in the NH setting) [6, 25, 26].

We reported the results as adjusted rate ratios (RR) with 95% confidence intervals (CIs). All *p*-values were from 2-sided tests, and we considered *p*-values less than 0.05 statistically significant. All analyses were conducted using SAS Enterprise Guide Version 8.3.

3 | Results

We identified 1368 NH MRPs who serviced 628 Ontario NHs during 2022 and provided care for 84,914 residents. The NH practice commitment varied (which was calculated as a proportion of NH residents over all patients), with most MRPs having a low practice commitment (mean practice commitment 15.4%, SD 27.5; Figure 1, Table 1). Only 114 (8.3%) had a $\geq 80\%$ practice commitment to NH.

Table 1 presents descriptive statistics of the cohort, organized by quintiles of NH practice commitment. MRPs with a greater NH practice commitment by quintile were older, male, and practiced in more urban areas, with more years of practice and lower FTE (Table 1). The average number of residents cared for ranged from 6.0 in the lowest quintile of practice commitment to 120.6 in the highest quintile (an average of 62.1 residents across all MRPs). Most MRPs (67.3%) practiced in one NH, but 29.2% in the highest quintile practiced in 3 or more NHs. We observed that MRPs with lower practice commitment were more likely to use fee-for-service compensation over monthly management payment models. Table S2 provides additional details on MRP practice outside of NH, with the top three care settings as other, primary care practice, and office practice.

3.1 | Outcomes

In the primary outcomes, 57% of all residents were prescribed antibiotics, 41% antipsychotics, 21% benzodiazepines, and 55%

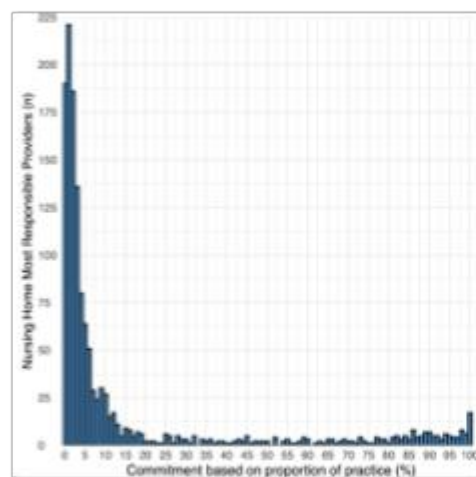


FIGURE 1 | NH practice commitment, based on the proportion of NH residents, among all NH MRPs in Ontario, Canada, 2022.

3+ CNS-active medications (Table 2). In the secondary outcomes, 29% of all residents were prescribed statins, and 19% of residents died (Table 2). There were 41.4 ED visits and 16.8 hospital admissions per 100 residents across all MRPs (Table 2).

3.2 | Associations Between Commitment and Resident Outcomes

Figure 2A,B visualizes the adjusted multivariable regression estimates for each outcome by measures of physician commitment. In our primary analysis, we found limited associations between the three measures of commitment and the primary and secondary outcomes examined.

For every 10% increase in MRP NH practice commitment, residents under their care had a decreased rate of ED visits (RR 0.99; 95% CI 0.98–0.99); we found no differences for all other outcomes by NH practice commitment. For every 5-year increase in MRP NH practice, we found that residents under their care had a higher rate of antibiotic prescriptions (RR 1.02; 95% CI 1.01–1.03), benzodiazepine prescriptions (RR 1.02; 95% CI 1.01–1.04), and death (RR 1.02; 95% CI 1.00–1.03), with no differences for other outcomes. Residents cared for by MRPs working in three or more NHs compared to one NH had higher rates of statin prescriptions (RR 1.07; 95% CI 1.00–1.15) and lower death rates (RR 0.89; 95% CI 0.83–0.96). No significant differences were found between MRPs who worked in two NHs versus one NH.

3.3 | Associations With Other Covariates

In examining adjusted associations with other covariates (Table 3), we observed no differences based on the MRPs sex. MRPs in rural areas or small towns had higher rates of antipsychotic (RR 1.12; 95% CI 1.04–1.17), benzodiazepine (RR 1.12; 95% CI 1.04–1.21), 3+ CNS-active prescriptions (RR 1.13; 95% CI 1.07–1.18), as well as all-cause death of residents they were caring for (RR 1.22; 95% CI 1.14–1.31), and lower rates of statin prescriptions (RR 0.85; 95% CI 0.80–0.91) and hospital admissions (RR 0.71; 95% CI 0.65–0.77). MRPs who trained outside of Canada had higher rates of benzodiazepine prescriptions (RR 1.11; 95% CI 1.02–1.19) and ED visits (RR 1.09; 95% CI 1.01–1.18). Those with more than one FTE had higher rates of ED visits (RR 1.16; 95% CI 1.03–1.31) and hospital admissions (RR 1.22; 95% CI 1.06–1.40). Unadjusted associations are available in Table S3.

3.4 | Sensitivity Analyses

We observed similar results when including MRPs assigned to at least 20 residents and using a threshold of 80% practice commitment (Table S4). MRPs with an 80% NH practice commitment had a significantly lower adjusted RR for ED visits (RR 0.90; 95% CI 0.83–0.99). For every 5-year increase in NH practice, we found a higher rate of antibiotic (RR 1.01; 95% CI 1.00–1.02) and benzodiazepine prescriptions (RR 1.03; 95% CI 1.01–1.05). MRPs working in three or more NHs compared to one NH had a lower rate of death (RR 0.92; 95% CI 0.86–0.99). We observed that female MRPs had lower rates of ED visits (RR 0.93; 95% CI 0.88–0.99), and those who trained outside

TABLE 1 | Practice characteristics of NH MRPs by quintile of practice commitment, Jan 1–Dec 31, 2022.

	Commitment (proportion of practice) of MRP by quintile					All physicians
	Q1 (lowest)	Q2	Q3	Q4	Q5 (highest)	
Commitment % to NH practice, mean (SD)	0.3 (0.3)	1.5 (0.3)	3.2 (0.7)	8.1 (2.8)	63.6 (28.8)	15.4 (27.5)
Physicians						
Count of MRPs, <i>n</i>	274	273	273	274	274	1368
Physician age (years), mean (SD)	50.0 (13.1)	50.0 (12.3)	49.5 (12.3)	53.0 (14.2)	57.4 (14.5)	52.0 (13.6)
Female physicians, <i>n</i> (%)	119 (43.4%)	126 (46.2%)	120 (44.0%)	102 (37.2%)	102 (37.2%)	569 (41.6%)
Physician years of practice, mean (SD) ^a	16.4 (11.4)	16.7 (10.6)	16.5 (10.4)	19.4 (10.9)	22.1 (10.4)	18.3 (11.0)
Physician years of practice in NH, mean (SD) ^a	12.0 (10.9)	11.8 (9.5)	12.9 (10.2)	15.4 (10.7)	17.4 (10.7)	13.9 (10.6)
Physician based in rural or small towns, <i>n</i> (%) ^b	88 (32.1%)	95 (34.8%)	66 (24.2%)	39 (14.2%)	31 (11.3%)	319 (23.3%)
Distance to NH practice (km), mean (SD) ^b	28.0 (131.6)	31.5 (149.3)	18.1 (66.0)	14.1 (33.5)	24.0 (87.1)	23.2 (102.7)
Physician training, <i>n</i> (%)						
CMG	147 (53.6%)	154 (56.4%)	145 (53.1%)	165 (60.2%)	190 (69.3%)	801 (58.6%)
IMG	36 (13.1%)	39 (14.3%)	47 (17.2%)	54 (19.7%)	41 (15.0%)	217 (15.9%)
Unknown	91 (33.2%)	80 (29.3%)	81 (29.7%)	55 (20.1%)	43 (15.7%)	350 (25.6%)
Full-time equivalent status^c						
Less than half-time	104 (38.0%)	119 (43.6%)	113 (41.4%)	123 (44.9%)	107 (39.1%)	566 (41.4%)
Half to full-time	81 (29.6%)	68 (24.9%)	85 (31.1%)	93 (33.9%)	108 (39.4%)	435 (31.8%)
Full-time	78 (28.5%)	77 (28.2%)	60 (22.0%)	41 (15.0%)	34 (12.4%)	290 (21.2%)
More than full-time	11 (4.0%)	9 (3.3%)	15 (5.5%)	17 (6.2%)	25 (9.1%)	77 (5.6%)
NH Practice						
Count of residents with an MRP, <i>n</i> ^d	1655 (10,341)	7196 (45,379)	14,900 (100,790)	28,122 (193,446)	33,041 (225,101)	84,914 (575,056)
Count of residents billed for by MRP, <i>n</i> ^d	5974 (47,174)	11,050 (79,818)	20,557 (154,400)	36,544 (282,194)	45,284 (347,670)	119,409 (911,255)
No. residents per MRP, mean (SD) ^d	6.0 (7.5)	26.4 (15.5)	54.6 (32.6)	102.6 (63.8)	120.6 (110.5)	62.1 (73.7)
No. residents per MRP, mean (SD) ^d (Adjusted)	37.7 (56.0)	166.2 (119.6)	369.2 (234.5)	706.0 (487.2)	821.5 (823.6)	420.4 (537.3)
No. residents billed for per MRP, mean (SD) ^d	21.8 (28.8)	40.5 (24.8)	75.3 (65.1)	133.4 (81.3)	165.3 (134.4)	87.3 (95.0)
No. residents billed for per MRP, mean (SD) ^d (Adjusted)	172.2 (293.0)	292.4 (236.6)	565.6 (766.2)	1029.9 (863.5)	1268.9 (1170.3)	666.1 (863.5)

(Continues)

TABLE 1 | (Continued)

	Commitment (proportion of practice) of MRP by quintile					All physicians
	Q1 (lowest)	Q2	Q3	Q4	Q5 (highest)	
No. of unique NH homes per MRP, mean (SD)	1.1 (0.5)	1.3 (0.6)	1.4 (0.8)	1.9 (1.1)	2.1 (1.6)	1.6 (1.1)
No. of NH homes a physician was MRP in, n (%)						
One NH home	243 (88.7%)	220 (80.6%)	192 (70.3%)	135 (49.3%)	131 (47.8%)	921 (67.3%)
Two NH homes	26–30 ^a	39–43 ^a	61 (22.3%)	78 (28.5%)	63 (23.0%)	271 (19.8%)
Three or more NH homes	1–5 ^a	10–14 ^a	20 (7.3%)	61 (22.3%)	80 (29.2%)	176 (12.9%)
Physician billings						
Proportion of total OHIP billings in NH, mean (SD)	8.1 (14.8)	22.0 (23.3)	39.0 (28.3)	54.7 (27.2)	71.5 (29.8)	39.1 (33.9)
Number of MRPs where ≥x% of billings were in NH, n (%)						
≥ 50%	9 (3.3%)	41 (15.0%)	101 (37.0%)	158 (57.7%)	211 (77.0%)	520 (38.0%)
≥ 60%	1–5 ^a	26–30 ^a	79 (28.9%)	138 (50.4%)	194 (70.8%)	442 (32.3%)
≥ 70%	1–5 ^a	9–13 ^a	56 (20.5%)	97 (35.4%)	174 (63.5%)	341 (24.9%)
≥ 80%	1–5 ^a	3–7 ^a	24 (8.8%)	60 (21.9%)	151 (55.1%)	243 (17.8%)
≥ 90%	1–5 ^a	1–5 ^a	1–5 ^a	19 (6.9%)	115 (42.0%)	141 (10.3%)
Proportion of NH residents billed over total patients, mean (SD)	1.7 (3.3)	3.4 (5.8)	5.6 (4.2)	14.7 (14.3)	52.0 (34.2)	15.5 (25.3)
Billing model used in NH, n (%)						
Fee-for-service	102 (37.2%)	41 (15.0%)	24 (8.8%)	14 (5.1%)	20 (7.3%)	201 (14.7%)
Monthly management	172 (62.8%)	232 (85.0%)	249 (91.2%)	260 (94.9%)	254 (92.7%)	1167 (85.3%)

Abbreviations: CMG, Canadian Medical Graduate; IMG, International Medical Graduate; MRP, most responsible provider; NH, nursing home; OHIP, Ontario Health Insurance Plan; SD, standard deviation.

^aStarting from the year 1991, based on the availability of data from the OHIP database.

^bBased on practice location.

^cCalculated based on the distribution of billings for all family physicians in the year 2022. Full-time indicates those with billings between the 40th and 60th percentiles, less than full-time for those below the 40th percentile, and more than full-time for those greater than the 60th percentile.

^dBased on MRP assignment.

^eSmall cells (<6) are suppressed in accordance with ICES Privacy Policy to reduce the risk of re-identification of any individual in population-level data.

TABLE 2 | NH resident outcomes by quintile of NH MRP practice commitment, Jan 1–Dec 31, 2022.

Outcome characteristics	Commitment of MRP by quintile					All physicians
	Q1 (lowest)	Q2	Q3	Q4	Q5 (highest)	
Primary outcomes						
Proportion of residents prescribed an antibiotic, mean (SD)	58.6 (26.0)	54.3 (17.1)	58.0 (15.2)	57.3 (13.8)	56.0 (15.7)	56.7 (17.4)
Proportion of residents prescribed an antipsychotic, mean (SD)	48.7 (40.8)	41.9 (27.9)	40.2 (18.8)	39.5 (18.0)	40.1 (19.2)	41.4 (24.6)
Proportion of residents prescribed a benzodiazepine, mean (SD)	26.3 (31.3)	21.3 (14.9)	18.7 (9.9)	20.0 (12.0)	19.3 (11.0)	21.0 (17.2)
Proportion of residents prescribed 3+ CNS-active medications, mean (SD)	62.9 (33.1)	54.9 (19.6)	52.7 (14.9)	52.3 (16.4)	51.9 (15.6)	54.6 (20.8)
Secondary outcomes						
Proportion of residents prescribed a statin, mean (SD)	21.2 (26.3)	28.3 (15.5)	30.4 (13.8)	31.7 (13.3)	31.0 (14.0)	28.5 (17.7)
Rate of residents with ED visits during NH stay per 100 residents, mean (SD)	38.7 (51.6)	42.8 (31.1)	42.6 (19.7)	43.0 (24.2)	40.1 (17.4)	41.4 (31.3)
Rate of residents with hospital admissions during NH stay per 100 residents, mean (SD)	12.5 (22.1)	16.5 (15.2)	18.2 (10.3)	18.8 (12.4)	17.9 (9.7)	16.8 (14.8)
Proportion of residents who died during NH stay, mean (SD)	30.0 (36.2)	16.3 (15.8)	15.2 (8.2)	16.3 (11.3)	16.4 (10.4)	18.8 (20.1)

Abbreviations: CNS, central nervous system; MRP, most responsible provider; NH, nursing home; SD, standard deviation.

of Canada had higher rates of benzodiazepine prescriptions (RR 1.12; 95% CI 1.03–1.21) and ED visits (RR 1.11; 95% CI 1.03–1.20).

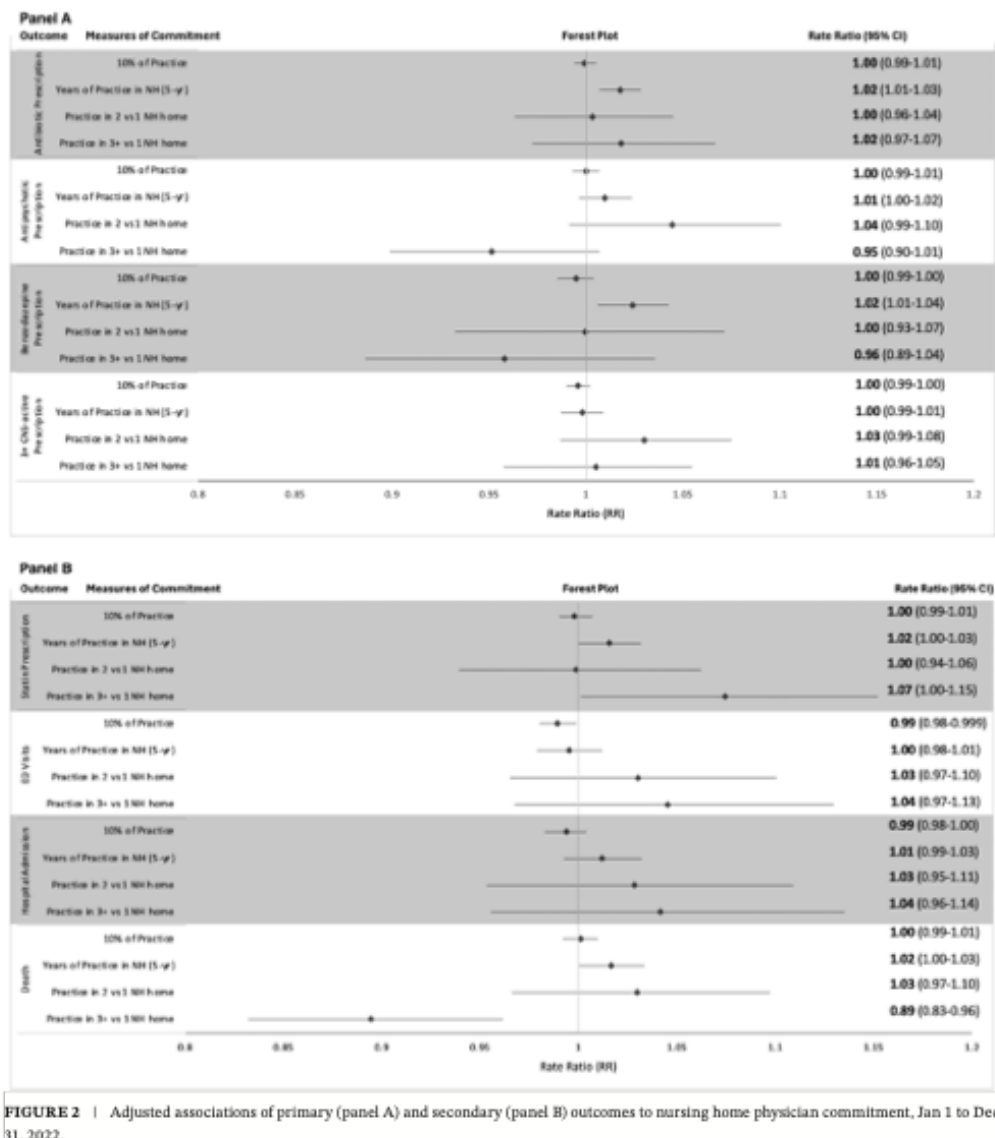
4 | Discussion

In this retrospective population-based study, we observed significant variation in NH MRP commitment. A small proportion (8.3%) had a highly focused and dedicated practice in NH, with $\geq 80\%$ practice commitment. Our results demonstrated no consistent associations between physician commitment and resident outcomes, with no clear links to medication prescriptions but a notable decrease in ED visits, particularly a 10% reduction for MRPs with $\geq 80\%$ practice commitment.

Our results suggest that no single aspect of NH physician commitment is strongly associated with resident care outcomes. However, differences in outcomes became apparent when multiple factors were considered together, such as practice commitment, years of practice, number of NHs worked in, practice

rurality, training location, and FTE status. These findings suggest that physician experience and training, workload intensity, and the degree to which they are stretched across multiple responsibilities may affect care quality delivered to residents. Our sensitivity analysis revealed that physician sex was linked to fewer ED visits, and internationally trained physicians showed differences in prescribing and ED visit patterns. Further research exploring the impact of physician sex and training on resident outcomes in the NH setting may be warranted, especially considering evidence from other settings suggesting female physicians were associated with better outcomes and more careful prescribing, while internationally trained physicians had lower mortality rates [27–30].

Measuring commitment in isolation was challenging, as different aspects of commitment yielded varying results. This aligns with previous research, which found no significant associations between medical care presence (physician and nurse practitioner) and outcomes when measured based on routine visits or active care planning involvement, while other work found that same-day physician availability reduced hospitalization rates



[31, 32]. This suggests that a single measure of commitment may not fully capture the complexity of physician engagement in NHs [5]. Future research could benefit from considering a more comprehensive measure of commitment that combines items such as the physician's physical presence and availability in the NH, the number of residents cared for, the time spent with residents, and cumulative experience in NHs based on residents cared for over time.

Physician commitment could also be influenced by other factors not captured in our definition, such as intrinsic motivation and behavioral factors. Physicians who find their work meaningful, fulfilling, and supported by a positive work environment and team could be more likely to remain engaged, experience job satisfaction, and avoid burnout [33–37]. Addressing work-related stress is essential for maintaining commitment and high-quality care, as burnout negatively

TABLE 3 | Physician characteristics and adjusted regression analysis of outcomes, Jan 1–Dec 31, 2022.

Characteristic	Primary outcomes				Secondary outcomes			
	Rate ratio (95% CI)				Rate ratio (95% CI)			
	Antibiotics prescription (n = 1368)	Antipsychotic prescription (n = 1215)	Benzodiazepine prescription (n = 1313)	3+ CNS-active prescription (n = 1313)	Statin prescription (n = 1368)	ED visits (n = 1368)	Hospital admission (n = 1368)	Death (n = 1368)
	Adjusted	Adjusted	Adjusted	Adjusted	Adjusted	Adjusted	Adjusted	Adjusted
Commitment variables								
1% of Practice	1.00 (1.00–1.00)	1.00 (1.00–1.00)	1.00 (1.00–1.00)	1.00 (1.00–1.00)	1.00 (1.00–1.00)	0.99 (0.99–0.999)	1.00 (1.00–1.00)	1.00 (1.00–1.00)
10% of Practice	1.00 (0.99–1.01)	1.00 (0.99–1.01)	1.00 (0.99–1.00)	1.00 (0.99–1.00)	1.00 (0.99–1.01)	0.99 (0.98–0.999)	0.99 (0.98–1.00)	1.00 (0.99–1.01)
Years of practice in NH (5-year)	1.02 (1.01–1.03)	1.01 (1.00–1.02)	1.02 (1.01–1.04)	1.00 (0.99–1.01)	1.02 (1.00–1.03)	1.00 (0.98–1.01)	1.01 (0.99–1.03)	1.02 (1.00–1.03)
# NHs an MRP bills in								
One NH	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Two NH	1.00 (0.96–1.04)	1.04 (0.99–1.10)	1.00 (0.93–1.07)	1.03 (0.99–1.08)	1.00 (0.94–1.06)	1.03 (0.97–1.10)	1.03 (0.95–1.11)	1.03 (0.97–1.10)
Three or more NH	1.02 (0.97–1.07)	0.95 (0.90–1.01)	0.96 (0.89–1.04)	1.01 (0.96–1.05)	1.07 (1.00–1.15)	1.04 (0.97–1.13)	1.04 (0.96–1.14)	0.89 (0.83–0.96)
Other covariates								
Physician sex (Female)	1.02 (0.99–1.06)	1.01 (0.96–1.06)	1.03 (0.97–1.10)	1.02 (0.99–1.07)	0.98 (0.93–1.03)	0.95 (0.89–1.00)	0.93 (0.87–1.00)	1.02 (0.96–1.08)
Physician in rural or small town	1.00 (0.96–1.05)	1.12 (1.04–1.17)	1.12 (1.04–1.21)	1.13 (1.07–1.18)	0.85 (0.80–0.91)	1.01 (0.94–1.08)	0.71 (0.65–0.77)	1.22 (1.14–1.31)
Physician training, n (%)								
CMG	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
IMG	1.00 (0.96–1.05)	0.97 (0.92–1.03)	1.11 (1.02–1.19)	1.03 (0.98–1.08)	1.04 (0.97–1.12)	1.09 (1.01–1.18)	1.03 (0.94–1.12)	1.01 (0.94–1.09)
Unknown	0.96 (0.91–1.01)	1.01 (0.94–1.08)	1.10 (1.00–1.20)	1.04 (0.98–1.10)	0.95 (0.88–1.03)	1.14 (1.05–1.24)	1.11 (1.00–1.22)	0.90 (0.83–0.98)

(Continues)

TABLE 3 | (Continued)

Characteristic	Primary outcomes				Secondary outcomes			
	Rate ratio (95% CI)				Rate ratio (95% CI)			
	Antibiotics prescription (n = 1368)	Antipsychotic prescription (n = 1215)	Benzodiazepine prescription (n = 1313)	3+ CNS-active prescription (n = 1313)	Statin prescription (n = 1368)	ED visits (n = 1368)	Hospital admission (n = 1368)	Death (n = 1368)
	Adjusted	Adjusted	Adjusted	Adjusted	Adjusted	Adjusted	Adjusted	Adjusted
Full-time equivalent status								
Less than half-time	1.02 (0.98–1.07)	1.00 (0.93–1.07)	1.12 (1.03–1.22)	1.01 (0.96–1.07)	0.97 (0.90–1.04)	1.05 (0.97–1.13)	1.06 (0.97–1.16)	0.95 (0.88–1.03)
Half to full-time	0.99 (0.95–1.05)	1.02 (0.95–1.10)	1.11 (1.02–1.22)	1.01 (0.96–1.07)	0.96 (0.89–1.03)	1.06 (0.98–1.14)	1.07 (0.97–1.17)	0.98 (0.91–1.06)
Full-time	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
More than full-time	1.01 (0.94–1.09)	1.02 (0.93–1.11)	1.10 (0.97–1.25)	0.99 (0.92–1.07)	0.99 (0.88–1.11)	1.16 (1.03–1.31)	1.22 (1.06–1.40)	0.96 (0.85–1.08)
NH billing model								
Monthly management	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Fee-for-service	0.94 (0.88–0.999)	1.07 (0.98–1.17)	1.12 (1.00–1.25)	1.03 (0.96–1.10)	0.90 (0.82–0.996)	1.06 (0.96–1.17)	0.92 (0.81–1.04)	1.11 (1.00–1.23)

Note: Bold items indicate significant confidence intervals.

Abbreviations: CMG, Canadian Medical Graduate; CNS, central nervous system; ED, emergency department; IMG, International Medical Graduate; MRP, most responsible provider; NH, nursing home.

impacts both well-being and care delivery [37, 38]. Efforts to reduce physician stress through organizational support, job satisfaction improvements, and adequate remuneration for time commitment could help alleviate burnout and foster a sustained commitment to NH practice. Recognizing physicians' roles within the care team may also enhance motivation and ensure consistent care delivery.

We found that NH residents under the care of committed physicians were not less likely to receive potentially inappropriate medications and, in some cases, were more likely to be prescribed antibiotics, antipsychotics, benzodiazepines, 3+ CNS-active medications, and statins. Despite NH physicians' knowledge of safe prescribing and deprescribing practices, managing polypharmacy remains challenging due to factors and barriers such as time constraints, resident complexity, resources, team competency to provide non-pharmacological interventions, resident and unpaid caregiver expectations, and systemic issues that may hinder sustained reductions in medication use [39–41]. Deprescribing involves more than simply deciding whether to continue or stop medications, which oversimplifies the process. The findings of our study align with Ryskina et al., who found no significant association between NH specialist physician involvement and the overall use of potentially hazardous medications, though specialists were associated with reduced prolonged medication use [42]. Future studies should examine medication duration and frequency, as risks increase with long-term use. Additionally, examining outcomes like rehospitalizations, hospital transfers in the last days of life, or indwelling bladder catheter use may offer valuable insights into the broader impact of physician commitment in the Canadian context [6, 25, 43]. While we included death as an outcome, higher mortality rates in NHs do not necessarily reflect poorer care, as physicians involved in palliative care in the home may see higher death rates. Examining the quality of death may provide more meaningful insights.

The mixed findings in this study could reflect the complexity of NH care, which is inherently interdisciplinary. Resident outcomes are not shaped only by physicians but by the broader healthcare teams, including personal support workers, nurses, allied health professionals, and specialists. It may be more productive to consider factors, such as team integration, staffing levels, turnover, team culture, leadership consistency, funding, and relationships between NHs and hospitals rather than focusing solely on individual physicians. Organizational models, such as closed/integrated models of care, where physicians and teams provide continuous care to a defined group of residents, have been linked to care quality [44–47]. This model suggests that structured, long-term relationships may foster more consistent and meaningful physician involvement. Improving communication is also crucial, as residents and unpaid caregivers often rate physicians lower than nursing staff. Barańska et al. (2020) found that family caregivers of dying residents in European NHs rated communication with physicians poorly, indicating a need for better physician–family interactions [48]. Enhancing physician involvement in care planning and communication could improve both perceived and actual care quality. Focusing on outcomes that matter to residents/caregivers instead of those important to providers, administrations, and policymakers may be closely linked with physician commitment (e.g., communication style, eye contact, physical touch, accessibility, and time spent in interactions). Incorporating these factors could

offer a more comprehensive understanding of improving care quality in NHs.

4.1 | Limitations

Our results should be considered in light of the following limitations. First, the observational nature of the study does not infer causality between NH physician commitment and quality-of-care outcomes. Second, our measures of physician commitment were based on administrative billing data, which do not capture key aspects of physician engagement, such as frequency and quality of visits, time spent with residents, or on-site presence. While our approach allowed for population-level analysis, it does not reflect the full complexity of physician practice in NHs. Future studies could benefit from incorporating information on visit duration and intensity or considering alternative methods to measure commitment more comprehensively. It is possible that the small number of MRPs with $\geq 80\%$ practice commitment was a factor in not seeing a greater impact.

Additionally, while our study assumes that prescribing decisions are largely under the control of the MRP, we acknowledge that, in practice, multiple factors, including interdisciplinary input and organizational policies and resources, as well as on-call coverage by other physicians, may influence prescribing behavior. While home-level data are unavailable in our administrative databases, factors such as staffing ratios, presence, vacancy, and turnover of nursing staff, organizational models, ownership type, and home size may influence the complex relationship between physician commitment and the outcomes of NH residents. Future research is needed to explore variations in outcomes at the resident, physician, and home levels. Furthermore, while we focused on specific medication classes, we did not differentiate between duration, number of medications, or appropriateness of these prescriptions, which could provide deeper insights into the role of physician commitment in medication management. Our use of administrative databases prevented us from assessing whether ED visits and hospital admissions were aligned with resident preferences in advanced care plans. Future work could also explore other relevant outcomes, such as functional status, resident satisfaction and preferences, and quality of life, which may provide a more holistic view of the impact of physician commitment on NH care.

5 | Conclusions

This study highlights the variability in physician commitment to NH care and its mixed associations with resident outcomes. While higher levels of physician commitment were linked to reduced ED visits, other expected improvements in resident outcomes chosen were not consistently observed. These findings suggest that the current measures of physician commitment may not fully capture the complexities of the physician's role in shaping the quality of resident care and do not impact the selected outcomes. Future research should explore more comprehensive and nuanced measures of commitment and responsive outcomes, as well as system-level factors that likely influence resident outcomes. Policymakers and healthcare

leaders should view physician commitment as one component of a broader, team-based care strategy as no single factor solely drives NH care outcomes. This approach should prioritize cohesive interdisciplinary teams and organizational structures that promote comprehensive, continuous care. Focusing on meaningful resident-centered outcomes will ensure that care delivery aligns with the needs and priorities of NH residents and their caregivers.

Author Contributions

D.D. and A.P.C. conceived the study and developed the design in collaboration with H.Y.-H.S., P.R.K., and A.T.J., D.D. and D.K. performed data curation, analysis, and interpretation and wrote the first draft. All authors contributed to the interpretation of the data and the revision of the manuscript. A.P.C. provided supervision, and A.P.C. and P.T. provided funding. Everyone who contributed significantly to this article has been listed.

Disclosure

Sponsor's role: This study used data adapted from the Statistics Canada Postal Code^{CM} Conversion File, which is based on data licensed from Canada Post Corporation, and/or data adapted from the Ontario Ministry of Health Postal Code Conversion File, which contains data copied under license from Canada Post Corporation and Statistics Canada. Parts of this material are based on data and/or information compiled and provided by CIHI and the Ontario Ministry of Health. The analyses, conclusions, opinions, and statements expressed herein are solely those of the authors and do not reflect those of the funding or data sources; no endorsement is intended or should be inferred. We thank IQVIA Solutions Canada Inc. for the use of their Drug Information File.

Conflicts of Interest

The authors declare no conflicts of interest.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.

Appendices

Dash et al. NH physician commitment and quality of care

Defining and Evaluating the Impact of Physician Commitment to Nursing Home Practice: A Population-level Cross-Sectional Study

Dash et al.

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Supplement Text S1: List of Data Sources Used

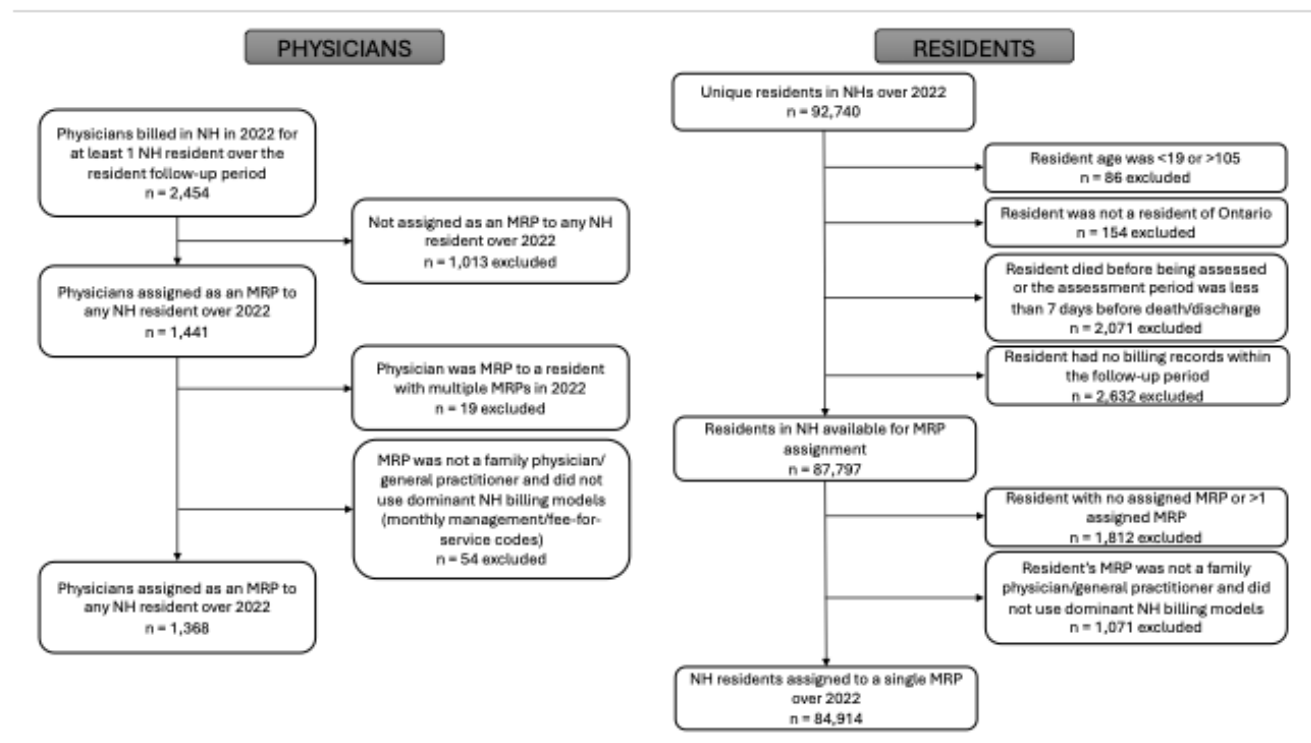
All data is housed at ICES (formerly the Institute of Clinical Evaluative Sciences) with secure access to data to study personnel. All data is received, processed, and cleaned at ICES before being available for use. The following Ontario health administrative databases were included in this study: Ontario Health Insurance Plan (OHIP), Continuing Care Reporting System (CCRS) housing the RAI-MDS 2.0, Registered Persons Database (RPDB), Corporate Provider Database (CPDB), ICES Physician Database (IPDB), Client Agency Program Enrolment (CAPE) database, Discharge Abstract Database (DAD), National Ambulatory Care Reporting System (NACRS), Ontario Drug Benefit (ODB), Ontario Mental Health Reporting System (OMHRS), Ontario institutions funded by the ministry (INST), and the Ontario Dementia Database (DEMENTIA).

Name	Description
Ontario Health Insurance Plan Claims Database (OHIP)	The OHIP claims databases contains data on services to Ontario residents eligible for publicly funded health insurance by physicians. In addition to unique identifiers of physicians and patients, the main data elements were service codes (for type of service provided), location of the service, the number of units provided, and the fee paid.
Continuing Care Reporting System (CCRS)	CCRS is a national standard supported by the Canadian Institute for Health Information (CIHI) to which all Ontario nursing home facilities are required to submit. It contains records of entry and discharge, as well as assessment records done with the Resident Assessment Instrument-Minimum Data Set 2.0 comprehensive assessment (RAI-MDS 2.0). A RAI-MDS 2.0 assessment is required to be done within the first 14 days for all stays of 14 days or longer, and then at 3-month intervals thereafter or sooner, in cases of significant clinical change. Information is used for individual care planning, outcome measurement, quality measurement (including public reporting), and for facility payment based on case mix. The CCRS also provides facility characteristics such as rural location and number of beds based on Statistics Canada's Postal Code Conversion File (PCCF).
Registered Persons Database (RPDB)	The RPDB provides basic demographic information on persons registered through OHIP and the Ontario Drug Benefit (ODB). Demographic information from a person's health card, such as age, sex, and postal code, are stored in the RPDB.
Corporate Provider Database (CPDB)	The CPDB is a repository of health provider and health provider organization data. It identifies service locations, health provider credentials, and health provider demographics.
ICES Physician Database (IPDB)	The IPDB contains additional physician information and their practice, and is constructed from several other databases including OHIP, CPDB, and the Ontario Physician Human Resources Data Centre (OPHRDC). Main data elements consist of physician

	demographics, specialty, location, and measures of physician activity and supply.
Client Agency Program Enrolment (CAPE) database	The CAPE database contains a list of patients enrolled in primary care physician models, including the patient's enrolment status (active or inactive).
Discharge Abstract Database (DAD)	The DAD captures comprehensive administrative, clinical, and demographic data from hospital records for discharges, deaths, transfers, and sign-outs. It includes information for all acute- and chronic-care hospitals and rehabilitation hospitals in Ontario.
The National Ambulatory Care Reporting System (NACRS)	The NACRS captures data for community-based and hospital-based ambulatory care (from day survey, outpatient and community-based clinics, and emergency departments).
The Ontario Drug Benefit (ODB) database	The ODB database contains records for all prescriptions dispensed for individuals covered under the ODB program. All nursing home residents are covered by the ODB program. Each record includes the Drug Identification Number (DIN), the type of drug, quantity dispensed, the date the drug was dispensed, and the number of days supplied for each drug.
The Ontario Mental Health Reporting System (OMHRS)	The OMHRS contains administrative and clinical data on individuals receiving adult mental health services in Ontario, at both admission and discharge.
Ontario health care institutions funded by the Ministry of Health and Long-Term Care (INST)	The INST database contains information on institution types and bed information of all institutions found in OHIP. The Master Numbering System (MNS) file contains information about each institution number. It gives the institution name, the location, type, the facility number it belongs to, and the time range it was in the MNS.
Ontario Dementia Database (DEMENTIA)	The DEMENTIA database is one of many ICES-derived cohorts using validated algorithms to identify people with specific disease. ¹ A combination of data sources are used to identify the prevalence of those with dementia.

¹Jaakkimainen RL, Bronskill SE, Tierney MC, et al. Identification of Physician-Diagnosed Alzheimer's Disease and Related Dementias in Population-Based Administrative Data: A Validation Study Using Family Physicians' Electronic Medical Records. *J Alzheimers Dis*. 2016;54(1):337-349. doi:10.3233/JAD-160105

Supplemental Figure S1. Inclusion and Exclusion Criteria



Supplemental Table S1: Correlation matrix of commitment metric versions

Description	Formula	Version	Version			
			1	2	3	4
Commitment % based on NH residents assigned to MRP over all patients rostered to MRP	$\frac{N_{residents}}{N_{all\ patients}} \times 100\%$	1	1.00	0.93	0.89	0.83
Commitment % based on adjusted numbers for NH residents assigned to MRP over all patients rostered to MRP	$\frac{N_{residents\ (adjusted)}}{N_{all\ patients\ (adjusted)}} \times 100\%$	2	0.93	1.00	0.85	0.88
Commitment % based on numbers for NH residents assigned to MRP times billings over all patients rostered to MRP times billings	$\frac{N_{residents} \times billings}{N_{all\ patients} \times billings} \times 100\%$	3	0.89	0.85	1.00	0.95
Commitment % based on adjusted numbers for NH residents assigned to MRP times billings over all patients rostered to MRP times billings	$\frac{N_{residents\ (adjusted)} \times billings}{N_{all\ patients\ (adjusted)} \times billings} \times 100\%$	4	0.83	0.88	0.95	1.00

Supplement Text S2: Outcome Specification

Eight outcomes were used in the analysis of NH MRP commitment. Four indicators were obtained from Ontario's MyPractice in Long-Term Care (MPLTC) report.²

In examining associations with resident outcomes, we excluded residents under the age of 19 and over the age of 105, non-Ontario residents, death before the date of assessment, a resident with an assessment period of less than 7 days, if no OHIP billings were rendered within the follow-up period, if the resident had no assigned MRP or more than one, if the resident's MRP was not a family physician/general practitioner, and if the resident's assigned MRP did not use the dominant billing models in NH practice (see Supplemental Figure 1).

The following details how each outcome was defined and applied in the study.

Outcome: Antibiotic Prescriptions*	
Description:	This measures the percentage of NH residents who had at least one antibiotic dispensed in 2022. These were prescribed by the assigned MRP. Due to data limitations, this indicator includes medications dispensed that are prescribed on an as-needed basis (PRN).
Numerator:	The number of NH residents with an MRP with at least one record of an antibiotic drug dispensed in 2022.
Denominator:	The total number of NH residents with an MRP in 2022.
List of medications:	See below
Calculation:	Numerator / Denominator X 100%
Data sources:	OHIP, RPDB, ODB
Regression model details:	Negative binomial regression modelled with the count (numerator) of the indicator as a rate per 100 residents Offset is the logarithm of total NH residents enlisted by the MRP
Outcome: Antipsychotic Prescriptions*	
Description:	This measures the percentage of NH residents diagnosed with dementia who were prescribed an antipsychotic medication in 2022. This indicator looks at all prescriptions. Exclusions: Diagnosis of psychosis, new to NH (<100 days), palliative care in last 6 months. Due to data limitations, this indicator includes medications dispensed that are prescribed on an as-needed basis (PRN).

²Health Quality Ontario. *Technical Appendix: MyPractice Long-Term Care*.; No date:41.

Numerator:	The number of NH residents with dementia without psychosis with an MRP with at least one record of an antipsychotic drug dispensed in 2022.
Denominator:	The total number of NH residents with an MRP in 2022 who are 66 years and older, diagnosed with dementia, without psychosis, not new to the NH, and not in palliative care.
List of medications:	See below
Calculation:	Numerator / Denominator X 100%
Data sources:	OHIP, RPDB, ODB, DAD, OMHRS, DEMENTIA
Regression model details:	Pearson-scaled Poisson modelled with the count (numerator) of the indicator as a rate per 100 residents Offset is the logarithm of the total number of NH residents with an MRP in 2022 who are 66 years and older, diagnosed with dementia, without psychosis, not new to the NH, and not in palliative care

Outcome: Benzodiazepine Prescriptions*

Description:	This measures the percentage of NH residents who had at least one benzodiazepine medication dispensed in 2022. This indicator looks at all prescriptions. Due to data limitations, this indicator includes medications dispensed that are prescribed on an as-needed basis (PRN). Exclusions: New to NH (<100 days), palliative care in last 6 months.
Numerator:	The number of NH residents with an MRP with at least one record of a benzodiazepine drug dispensed in 2022.
Denominator:	The total number of NH residents with an MRP in 2022 who are 66 years and older, not new to the NH, and not in palliative care.
List of medications:	See below
Calculation:	Numerator / Denominator X 100%
Data sources:	OHIP, RPDB, ODB, DAD, OMHRS
Regression model details:	Negative binomial regression modelled with the count (numerator) of the indicator as a rate per 100 residents Offset is the logarithm the total number of NH residents with an MRP in 2022 who are 66 years and older, not new to the NH, and not in palliative care

Outcome: Three or more CNS-active Medication Prescriptions*

Description:	This measures the estimated percentage of NH residents who had three or more medications dispensed with central nervous system
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	(CNS) activity in 2022. This is estimated on a given day over 2022 and the indicator looks at all prescriptions. Due to data limitations, this indicator includes medications dispensed that are prescribed on an as-needed basis (PRN). Exclusions: New to NH (<100 days), palliative care in last 6 months.
Numerator:	The number of NH residents with an MRP who had three or more specified CNS-active medications dispensed in 2022.
Denominator:	The total number of NH residents with an MRP in 2022 who are 66 years and older, not new to the NH, and not in palliative care.
List of medications:	Includes antipsychotics, opioids, oral benzodiazepines, and antidepressants, see specific list below.
Calculation:	Numerator / Denominator X 100%
Data sources:	OHIP, RPDB, ODB, DAD, OMHRS
Regression model details:	Negative binomial regression modelled with the count (numerator) of the indicator as a rate per 100 residents Offset is the logarithm the total number of NH residents with an MRP in 2022 who are 66 years and older, not new to the NH, and not in palliative care
Outcome: Statin Prescriptions³	
Description:	This measures the percentage of NH residents who had at least one statin dispensed in 2022. These were prescribed by the assigned MRP. Due to data limitations, this indicator includes medications dispensed that are prescribed on an as-needed basis (PRN).
Numerator:	The number of NH residents with an MRP with at least one record of a statin drug dispensed in 2022.
Denominator:	The total number of NH residents with an MRP in 2022.
List of medications:	See below
Calculation:	Numerator / Denominator X 100%
Data sources:	OHIP, RPDB, ODB
Regression model details:	Negative binomial regression modelled with the count (numerator) of the indicator as a rate per 100 residents Offset is the logarithm of total NH residents enlisted by the MRP

³ Campitelli MA, Maxwell CJ, Giannakeas V, et al. The Variation of Statin Use Among Nursing Home Residents and Physicians: A Cross-Sectional Analysis. *Journal of the American Geriatrics Society*. 2017;65(9):2044-2051. doi:10.1111/jgs.15013

Outcome: Emergency Department (ED) Visits	
Description:	This measures the number of ED visits for NH residents in 2022.
Numerator:	The number of NH residents with an MRP with at least one record of an ED visit in 2022.
Denominator:	The total number of NH residents with an MRP in 2022.
Calculation:	Numerator / Denominator X 100%
Data sources:	OHIP, NACRS
Regression model details:	Negative binomial regression modelled with the count (numerator) of the indicator as a rate per 100 residents Offset is the logarithm of NH total residents enlisted by the MRP
Outcome: Hospital Admissions	
Description:	This measures the number of hospital admission for NH residents in 2022.
Numerator:	The number of NH residents with an MRP with at least one record of a hospital admission in 2022.
Denominator:	The total number of NH residents with an MRP in 2022.
Calculation:	Numerator / Denominator X 100%
Data sources:	OHIP, DAD
Regression model details:	Negative binomial regression modelled as with the count (numerator) of the indicator as a rate per 100 residents Offset is the logarithm of total NH residents enlisted by the MRP
Outcome: Death of Residents	
Description:	This measures the number of NH residents who died in 2022.
Numerator:	The number of NH residents with an MRP who died in 2022.
Denominator:	The total number of NH residents with an MRP in 2022.
Calculation:	Numerator / Denominator X 100%
Data sources:	OHIP, RPDB
Regression model details:	Negative binomial regression modelled with the count (numerator) of the indicator as a rate per 100 residents Offset is the logarithm of total NH residents enlisted by the MRP

*adapted from MPLTC reports

List of Medications by Drug Class Used in Outcome Calculations

Drug Class	Medications
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Antibiotics	Aminoglycosides: Amikacin; Gentamicin; Paromomycin** excluded; Tobramycin Antibacterial/Antiprotozoal: Metronidazole Carbapenems: Ertapenem Cephalosporin (1st Generation): Cephalexin; Cefadroxil; Cefazolin Cephalosporin (2nd Generation): Cefaclor; Cefprozil; Cefuroxime; Cefoxitin Cephalosporin (3rd Generation): Ceftazidime; Ceftriaxone; Cefixime Fluoroquinolones: Ciprofloxacin; Levofloxacin; Moxifloxacin; Norfloxacin; Ofloxacin Glycopeptides: Vancomycin Lincosamides: Clindamycin Macrolides: Azithromycin; Clarithromycin; Erythromycin Penicillins: Amoxicillin; Ampicillin; Cloxacillin; Penicillin Sulfonamides, Trimethoprim and combination: Sulfamethoxazole & Trimethoprim; Trimethoprim Tetracyclines: Doxycycline; Minocycline; Tetracycline; Tigecycline Urinary Anti-infectives: Fosfomycin; Methenamine; Nitrofurantoin; Other Antibiotics: Colistin/Colistimethate; Daptomycin; Fidaxomicin; Linezolid
Antipsychotics	Typical: Chlorpromazine; Flupentixol; Fluphenazine; Haloperidol; Loxapine; Methotrimeprazine; Periciazine; Perphenazine; Pimozide; Pipotiazine; Thioridazine**; Thiothixene; Trifluoperazine; Zuclopenthixol Atypical: Aripiprazole; Asenapine; Clozapine; Olanzapine; Lurasidone; Paliperidone; Quetiapine; Risperidone; Ziprasidone
Benzodiazepines (oral formulations only)	Alprazolam; Bromazepam; Chlordiazepoxide; Chlordiazepoxide HCL; Chlordiazepoxide HCL & Clidinium HCL; Clonazepam; Clorazepate Dipotassium; Diazepam; Estazolam; Flurazepam HCL; Ketazolam; Lorazepam; Nitrazepam; Oxazepam; Temazepam; Triazolam
Opioids*	Codeine; Oxycodone; Anileridine**; Opium; Buprenorphine; Dextropropoxyphene; Fentanyl; Hydromorphone; Levorphanol; Meperidine; Methadone; Morphine; Oxymorphone; Propoxyphene; Sufentanil
Antidepressants*	Amitriptyline; Amoxapine; Bupropion; Citalopram; Clomipramine; Desipramine; Desvenlafaxine; Doxepin; Duloxetine; Escitalopram; Fluoxetine; Fluvoxamine; Imipramine; Mirtazapine; Moclobemide; Nefazodone; Nortriptyline; Paroxetine; Phenelzine; Protriptyline; Sertraline; Tranylcypromine; Trazodone; Trimipramine; Tryptophan; Venlafaxine; Vortioxetine
Statins	Atorvastatin Calcium; Atorvastatin Calcium & Amlodipine Besylate combination; Fluvastatin; Fluvastatin Sodium; Lovastatin; Pravastatin Sodium; Rosuvastatin Calcium; Simvastatin

*Includes NSAIDs and other combination medications that have an opioid in the formulation.

**No longer manufactured or available in Canada.

Supplemental Table S2. Additional practice characteristics of NH MRPs by quintile of commitment, Jan 1 - Dec 31, 2022

	Commitment (proportion of practice) of MRP by Quintile					All physicians
	Q1 (lowest)	Q2	Q3	Q4	Q5 (highest)	
TOTAL PATIENTS ACROSS ANY SETTING						
Count of total patients rostered in 2022, n ^a	519,850 (792,400)	470,152 (744,981)	462,743 (813,623)	366,115 (805,450)	77,355 (360,643)	1,896,215 (3,517,097)
Count of total patients billed in 2022, n ^a	464,395 (1,112,048)	406,283 (978,355)	401,948 (1,089,229)	327,781 (1,152,027)	154,319 (1,079,123)	1,754,726 (5,410,782)
No. patients rostered for in 2022, mean (SD) ^a	1897.3 (1450.7)	1722.2 (881.7)	1695.0 (823.0)	1336.2 (741.5)	282.3 (420.2)	1386.1 (1092.5)
No. patients rostered for in 2022, mean (SD) ^a (Adjusted)	2892.0 (2180.2)	2728.9 (1433.8)	2980.3 (1486.1)	2939.6 (1854.7)	1316.2 (1414.2)	2571.0 (1812.8)
No. patients billed for in 2022, mean (SD) ^a	1694.9 (1275.1)	1488.2 (698.9)	1472.3 (761.3)	1196.3 (685.6)	563.2 (629.7)	1282.7 (930.2)
No. patients billed for in 2022, mean (SD) ^a (Adjusted)	4058.6 (3088.5)	3583.7 (1931.1)	3989.9 (2725.4)	4204.5 (3455.0)	3938.4 (4010.0)	3955.3 (3124.5)
PRACTICE OUTSIDE OF NH						
Count of community patients rostered, n ^b	517,514 (776,811)	462,388 (693,778)	446,897 (703,570)	336,530 (596,352)	43,203 (123,933)	1,806,532 (2,894,443)
Count of community patients billed for, n ^b	458,421 (1,064,874)	395,233 (898,537)	381,391 (934,829)	291,237 (869,834)	109,035 (731,453)	1,635,317 (4,499,526)
No. community patients rostered per MRP, mean (SD) ^b	1888.7 (1446.7)	1693.7 (867.5)	1637.00 (792.6)	1228.2 (689.2)	157.7 (341.8)	1320.6 (1093.7)
No. community patients rostered per MRP, mean (SD) ^b (Adjusted)	2835.1 (2146.4)	2541.3 (1333.5)	2577.2 (1301.9)	2176.5 (1519.3)	452.3 (756.5)	2115.8 (1710.0)
No. community patients billed for per MRP, mean (SD) ^b	1673.1 (1269.0)	1447.7 (688.9)	1397.0 (726.9)	1062.9 (655.0)	397.9 (603.1)	1195.4 (936.5)
No. community patients billed for per MRP, mean (SD) ^b (Adjusted)	3886.4 (3036.8)	3291.3 (1861.3)	3424.3 (2449.5)	3174.6 (3280.0)	2669.5 (3795.9)	3289.1 (2984.3)
PHYSICIAN BILLINGS						
Proportion of total OHIP billings made up of: mean (SD)						
with primary feecodes to primary care practice	45.1 (14.1)	42.0 (13.0)	38.5 (13.1)	30.7 (14.7)	7.7 (11.5)	32.8 (18.9)
with primary feecodes to primary care practice for patients aged 75+	8.6 (5.1)	8.2 (4.8)	8.0 (4.6)	8.0 (6.8)	3.9 (6.1)	7.4 (5.8)
Office practice	28.7 (13.0)	25.9 (11.6)	23.3 (11.0)	19.0 (11.5)	6.2 (9.6)	20.6 (13.8)

Hospital practice	5.1 (7.5)	4.7 (7.7)	3.84 (7.7)	4.0 (9.3)	6.9 (13.5)	4.9 (9.5)
ED practice	3.3 (7.0)	3.2 (7.4)	2.2 (6.3)	1.8 (6.9)	2.4 (11.3)	2.6 (8.0)
Home based practice	0.6 (2.6)	0.3 (0.8)	0.3 (0.8)	0.5 (1.3)	0.8 (2.4)	0.5 (1.7)
All others	59.4 (12.8)	57.5 (13.4)	52.4 (13.6)	43.0 (16.8)	22.1 (21.5)	46.9 (21.0)
Billing model used for primary care practice, n (%)						
Solo fee-for-service	22 (8.0%)	18 (6.6%)	14 (5.1%)	40 (14.6%)	128 (46.7%)	222 (16.2%)
Enhanced fee-for-service	21 (7.7%)	19 (7.0%)	29 (10.6%)	36 (13.1%)	43 (15.7%)	148 (10.8%)
Non-team based capitation	72 (26.3%)	76 (27.8%)	94 (34.4%)	103 (37.6%)	42 (15.3%)	387 (28.3%)
Team based capitation	141 (51.5%)	140 (51.3%)	127 (46.5%)	88 (32.1%)	52 (19.0%)	548 (40.1%)
Other patient enrollment models	18 (6.6%)	20 (7.3%)	9 (3.3%)	7 (2.6%)	9 (3.3%)	63 (4.6%)
Referrals for NH residents						
Total number of referrals, n	207	1065	2491	4558	6005	14326
No. referrals by MRP, mean (SD)	0.8 (1.5)	3.9 (4.0)	9.1 (9.4)	16.6 (16.2)	21.9 (29.2)	10.5 (17.5)
No. referrals by MRP, median (Q1-Q3)	0 (0-1)	3 (1-6)	7 (3-12)	13 (6-22)	12 (5-28)	5 (1-13)
Distribution of specialist referrals, n (%)						
Diagnostic	0 (0.0%)	*1-5	*9-13	18 (0.4%)	17 (0.3%)	49 (0.3%)
ED	0 (0.0%)	*1-5	*5-9	18 (0.4%)	20 (0.3%)	48 (0.3%)
FP/GP	49 (23.7%)	267 (25.1%)	603 (24.2%)	1,172 (25.7%)	1,681 (28.0%)	3,772 (26.3%)
Medical	95 (45.9%)	462 (43.4%)	1,125 (45.2%)	2,157 (47.3%)	3,066 (51.1%)	6,905 (48.2%)
Surgical	63 (30.4%)	330 (31.0%)	745 (29.9%)	1,193 (26.2%)	1,221 (20.3%)	3,552 (24.8%)

MRP = most responsible provider, NH = nursing home, SD = standard deviation, OHIP = Ontario Health Insurance Plan, ED = emergency department, FP/GP = family practitioner/general practitioner, CAPE = Client Agency Program Enrollment database

^aBased on MRP assignment, virtual rosters, and CAPE

^bBased on virtual rosters, and CAPE

Supplemental Table S3. Physician characteristics and unadjusted regression analysis of outcomes, Jan 1 - Dec 31, 2022

	Primary Outcomes Rate Ratio (95% CI)				Secondary Outcomes Rate Ratio (95% CI)			
	Antibiotics Prescription (n=1368)	Antipsychoti c Prescription (n=1215)	Benzodiazepine Prescription (n=1313)	3+ CNS-active Prescription (n=1313)	Statin Prescription (n=1368)	ED Visits (n=1368)	Hospital Admission (n=1368)	Death (n=1368)
Characteristic	Unadjusted	Unadjusted	Unadjusted	Unadjusted	Unadjusted	Unadjusted	Unadjusted	Unadjusted
Commitment Variables								
1% of Practice	1.00 (1.00-1.00)	1.00 (1.00-1.00)	1.00 (1.00-1.00)	0.999 (0.999-0.999)	1.00 (1.00-1.00)	0.998 (0.998-0.999)	1.00 (1.00-1.00)	1.00 (1.00-1.00)
Years of practice in NH (5-yr)	1.02 (1.01-1.03)	1.01 (1.00-1.02)	1.01 (0.99-1.02)	0.99 (0.98-0.999)	1.02 (1.01-1.04)	0.98 (0.97-0.996)	1.01 (0.99-1.02)	1.02 (1.01-1.04)
# NHs an MRP bills in								
One NH	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
Two NH	1.01 (0.97-1.05)	1.04 (0.99-1.09)	1.00 (0.93-1.07)	1.02 (0.97-1.06)	1.02 (0.96-1.08)	1.03 (0.96-1.10)	1.05 (0.97-1.14)	1.03 (0.97-1.10)
Three or more NH	1.03 (0.99-1.08)	0.94 (0.90-0.99)	0.95 (0.89-1.03)	0.98 (0.93-1.02)	1.13 (1.05-1.20)	1.04 (0.96-1.11)	1.12 (1.03-1.21)	0.88 (0.82-0.94)
Other Covariates								
Physician Sex (Female)	0.99 (0.96-1.03)	1.00 (0.95-1.05)	1.00 (0.95-1.06)	1.03 (0.99-1.07)	0.95 (0.90-0.999)	0.95 (0.90-1.01)	0.90 (0.85-0.96)	1.00 (0.94-1.05)
Physician in rural or small town	0.98 (0.94-1.03)	1.12 (1.06-1.19)	1.13 (1.04-1.21)	1.13 (1.08-1.19)	0.82 (0.77-0.88)	1.01 (0.95-1.09)	0.69 (0.63-0.75)	1.24 (1.16-1.33)
Physician Training, n (%)								
CMG	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
IMG	0.99 (0.95-1.03)	0.95 (0.90-1.01)	1.08 (1.00-1.16)	1.02 (0.98-1.07)	1.05 (0.98-1.12)	1.11 (1.03-1.19)	1.05 (0.97-1.15)	0.97 (0.90-1.04)
Unknown	0.91 (0.87-0.95)	0.98 (0.92-1.04)	1.03 (0.96-1.11)	1.05 (1.01-1.10)	0.90 (0.85-0.96)	1.16 (1.08-1.23)	1.04 (0.96-1.13)	0.86 (0.80-0.92)
Full-time equivalent Status								
Less than half-time	1.02 (0.98-1.07)	0.97 (0.91-1.04)	1.09 (1.00-1.19)	1.00 (0.95-1.05)	1.00 (0.93-1.08)	1.05 (0.98-1.13)	1.11 (1.01-1.21)	0.93 (0.86-1.00)

Half to full-time	1.00 (0.96-1.06)	0.98 (0.92-1.05)	1.08 (0.98-1.17)	0.99 (0.94-1.04)	1.01 (0.93-1.08)	1.06 (0.98-1.14)	1.13 (1.03-1.24)	0.94 (0.87-1.02)
Full-time	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
More than full-time	1.02 (0.95-1.09)	0.96 (0.88-1.04)	1.04 (0.93-1.18)	0.96 (0.89-1.04)	1.08 (0.97-1.20)	1.20 (1.07-1.35)	1.37 (1.19-1.56)	0.86 (0.77-0.96)
NH Billing Model								
Monthly Management	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
Fee-for-service	0.94 (0.89-1.01)	1.12 (1.02-1.22)	1.16 (1.04-1.29)	1.07 (1.00-1.14)	0.86 (0.78-0.95)	1.04 (0.94-1.14)	0.82 (0.72-0.92)	1.22 (1.10-1.35)

Bold items indicate significant confidence intervals. MRP = most responsible provider, NH = nursing home, CNS = central nervous system, ED = emergency department, CMG = Canadian Medical Graduate, IMG = International Medical Graduate

Supplemental Table S4. Sensitivity analysis (excludes MRPs with <20 enlisted residents, and threshold of 80% NH practice commitment)

	Primary Outcomes Rate Ratio (95% CI)				Secondary Outcomes Rate Ratio (95% CI)			
	Antibiotics Prescription (n=955)	Antipsychotic Prescription (n=952)	Benzodiazepine Prescription (n=954)	3+ CNS-active Prescription (n=954)	Statin Prescription (n=955)	ED Visits (n=955)	Hospital Admission (n=955)	Death (n=955)
Characteristic	Adjusted	Adjusted	Adjusted	Adjusted	Adjusted	Adjusted	Adjusted	Adjusted
Commitment Variables								
Less than 80% of practice	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
80% or more of practice	1.00 (0.95- 1.05)	1.02 (0.96- 1.09)	0.98 (0.89-1.07)	0.97 (0.92- 1.03)	0.98 (0.91- 1.07)	0.90 (0.83- 0.99)	0.95 (0.86- 1.05)	0.98 (0.91- 1.07)
Years of practice in NH (5-yr)	1.01 (1.00- 1.02)	1.01 (1.00- 1.02)	1.03 (1.01-1.05)	1.00 (0.99- 1.01)	1.02 (1.00- 1.03)	0.99 (0.97- 1.01)	1.01 (0.99- 1.03)	1.01 (0.99- 1.03)
# NHs an MRP bills in								
One NH	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Two NH	0.99 (0.95- 1.03)	1.05 (0.99- 1.11)	0.99 (0.92-1.06)	1.03 (0.98- 1.08)	0.98 (0.92- 1.04)	1.04 (0.97- 1.11)	1.04 (0.96- 1.12)	1.05 (0.98- 1.12)
Three or more NH	1.00 (0.95- 1.04)	0.95 (0.90- 1.01)	0.95 (0.88-1.03)	1.01 (0.96- 1.06)	1.05 (0.97- 1.12)	1.04 (0.97- 1.12)	1.05 (0.96- 1.14)	0.92 (0.86- 0.99)
Other Covariates								
Physician Sex (Female)	1.02 (0.99- 1.06)	1.01 (0.96- 1.06)	1.04 (0.97-1.11)	1.03 (0.99- 1.07)	0.98 (0.93- 1.04)	0.93 (0.88- 0.99)	0.94 (0.87- 1.01)	1.01 (0.95- 1.08)
Physician in rural or small town	1.00 (0.95- 1.05)	1.10 (1.03- 1.17)	1.11 (1.02-1.21)	1.14 (1.08- 1.20)	0.85 (0.79- 0.92)	0.96 (0.89- 1.03)	0.70 (0.63- 0.77)	1.24 (1.15- 1.33)
Physician Training, n (%)								
CMG	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
IMG	0.99 (0.95- 1.04)	0.98 (0.92- 1.04)	1.12 (1.03-1.21)	1.03 (0.98- 1.08)	1.04 (0.97- 1.12)	1.11 (1.03- 1.20)	1.05 (0.96- 1.14)	1.00 (0.93- 1.07)
Unknown	0.97 (0.92- 1.02)	1.01 (0.94- 1.09)	1.14 (1.03-1.25)	1.04 (0.98- 1.10)	0.99 (0.91- 1.08)	1.12 (1.03- 1.22)	1.15 (1.04- 1.27)	0.89 (0.82- 0.97)
Full-time equivalent Status								

Less than half-time	1.03 (0.97-1.08)	1.01 (0.94-1.09)	1.15 (1.05-1.26)	1.02 (0.96-1.08)	1.00 (0.92-1.08)	1.04 (0.96-1.12)	1.04 (0.95-1.15)	0.97 (0.90-1.05)
Half to full-time	1.00 (0.95-1.06)	1.04 (0.96-1.12)	1.15 (1.04-1.26)	1.02 (0.96-1.08)	0.98 (0.91-1.07)	1.05 (0.96-1.14)	1.05 (0.95-1.16)	1.00 (0.92-1.08)
Full-time	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
More than full-time	1.01 (0.94-1.10)	1.03 (0.94-1.14)	1.15 (1.00-1.31)	0.99 (0.91-1.08)	1.03 (0.92-1.16)	1.13 (1.00-1.28)	1.17 (1.02-1.35)	0.98 (0.87-1.10)
NH Billing Model								
Monthly Management	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
Fee-for-service	0.99 (0.92-1.07)	1.07 (0.97-1.18)	1.09 (0.96-1.24)	1.01 (0.93-1.10)	0.95 (0.84-1.06)	1.03 (0.92-1.16)	0.93 (0.81-1.07)	0.98 (0.87-1.10)

Bold items indicate significant confidence intervals. MRP = most responsible provider, NH = nursing home, CNS = central nervous system, ED = emergency department, CMG = Canadian Medical Graduate, IMG = International Medical Graduate

Appendix 1. Completed Record Statement

The RECORD statement – checklist of items, extended from the STROBE statement, that should be reported in observational studies using routinely collected health data.

	Item No.	STROBE items	Location in manuscript where items are reported	RECORD items	Location in manuscript where items are reported
Title and abstract					
	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	Lines 1-2, 70 Lines 64-90	RECORD 1.1: The type of data used should be specified in the title or abstract. When possible, the name of the databases used should be included. RECORD 1.2: If applicable, the geographic region and timeframe within which the study took place should be reported in the title or abstract. RECORD 1.3: If linkage between databases was conducted for the study, this should be clearly stated in the title or abstract.	Lines 70-71 Lines 68-71 Line 70
Introduction					
Background rationale	2	Explain the scientific background and rationale for the investigation being reported	Lines 94-120		
Objectives	3	State specific objectives, including any prespecified hypotheses	Lines 125-130		
Methods					
Study Design	4	Present key elements of study design early in the paper	Lines 135-136		
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Lines 136-140		

Participants	6	(a) <i>Cohort study</i> - Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> - Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> - Give the eligibility criteria, and the sources and methods of selection of participants (b) <i>Cohort study</i> - For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> - For matched studies, give matching criteria and the number of controls per case	Lines 155-168	RECORD 6.1: The methods of study population selection (such as codes or algorithms used to identify subjects) should be listed in detail. If this is not possible, an explanation should be provided. RECORD 6.2: Any validation studies of the codes or algorithms used to select the population should be referenced. If validation was conducted for this study and not published elsewhere, detailed methods and results should be provided. RECORD 6.3: If the study involved linkage of databases, consider use of a flow diagram or other graphical display to demonstrate the data linkage process, including the number of individuals with linked data at each stage.	Lines 155-168 Lines 157-158 Lines 144-145
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.		RECORD 7.1: A complete list of codes and algorithms used to classify exposures, outcomes, confounders, and effect modifiers should be provided. If these cannot be reported, an explanation should be provided.	Lines 170-211 Supplemental Text 1 and 2
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Lines 170-199		

Bias	9	Describe any efforts to address potential sources of bias	Lines 135-198		
Study size	10	Explain how the study size was arrived at	Lines 155-168 Supplemental Figure 1		
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	Lines 170-211		
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> - If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> - If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> - If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses	Lines 214-230		

Data access and cleaning methods		..		RECORD 12.1: Authors should describe the extent to which the investigators had access to the database population used to create the study population. RECORD 12.2: Authors should provide information on the data cleaning methods used in the study.	Lines 150-151 Line 144
Linkage		..		RECORD 12.3: State whether the study included person-level, institutional-level, or other data linkage across two or more databases. The methods of linkage and methods of linkage quality evaluation should be provided.	Lines 144-145, 155-157
Results					
Participants	13	(a) Report the numbers of individuals at each stage of the study (<i>e.g.</i>, numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed) (b) Give reasons for non-participation at each stage. (c) Consider use of a flow diagram	Supplemental Figure 1 Lines 234-235	RECORD 13.1: Describe in detail the selection of the persons included in the study (<i>i.e.</i> , study population selection) including filtering based on data quality, data availability and linkage. The selection of included persons can be described in the text and/or by means of the study flow diagram.	Lines 155-168 Supplemental Figure 1 Lines 234-235
Descriptive data	14	(a) Give characteristics of study participants (<i>e.g.</i>, demographic, clinical, social) and information on exposures and potential confounders (b) Indicate the number of participants with missing data for each variable of interest	Lines 234-249 Figure 1 Table 1 Supplemental Table 2		

		(c) <i>Cohort study</i> - summarise follow-up time (e.g., average and total amount)			
Outcome data	15	<i>Cohort study</i> - Report numbers of outcome events or summary measures over time <i>Case-control study</i> - Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> - Report numbers of outcome events or summary measures	Lines 251-256 Table 2		
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Supplemental Table 3 Table 3 Lines 264-284 Lines 171-211		
Other analyses	17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	Lines 286-295		
Discussion					
Key results	18	Summarise key results with reference to study objectives	Lines 299-304		
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision.	Lines 381-407	RECORD 19.1: Discuss the implications of using data that were not created or collected to answer the specific research question(s). Include	Lines 319-328 Lines 381-407

		Discuss both direction and magnitude of any potential bias		discussion of misclassification bias, unmeasured confounding, missing data, and changing eligibility over time, as they pertain to the study being reported.	
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Lines 306-365		
Generalisability	21	Discuss the generalisability (external validity) of the study results	Lines 302-378		
Other Information					
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Lines 38-43		
Accessibility of protocol, raw data, and programming code		..		RECORD 22.1: Authors should provide information on how to access any supplemental information such as the study protocol, raw data, or programming code.	Referenced in manuscript, and supplemental files.

*Reference: Benchimol EI, Smeeth L, Guttman A, Harron K, Moher D, Petersen I, Sørensen HT, von Elm E, Langan SM, the RECORD Working Committee. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) Statement. *PLoS Medicine* 2015; in press.

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CHAPTER THREE

Establishing primary care physician commitment in Canadian long-term care homes: a protocol for a modified e-Delphi study

Summary

The third chapter describes the methodology of a modified e-Delphi consensus study designed to establish expectations for primary care physician (PCP) commitment in Canadian long-term care (LTC) homes. Building directly on the findings from Chapter 2, which demonstrated that administrative measures inadequately capture the complexity of physician commitment, I developed a rigorous consensus methodology to create a comprehensive, data-agnostic framework for expectations of commitment. The protocol employs a two-round modified e-Delphi approach with an expert panel of frontline LTC physicians from across Canada, incorporating both quantitative ratings and qualitative feedback to evaluate candidate statements on relevance and feasibility. This methodological innovation addresses the critical gap identified in Chapter 2 by moving beyond billing-based measures to establish consensus-based expectations that can be applied across diverse data sources and practice settings.

The study protocol was designed following established guidelines (RAND and ACCORD) and includes a virtual meeting component between rounds to facilitate in-depth discussion among geographically dispersed experts. The consensus-building approach ensures that the resulting framework reflects the collective expertise of Canadian LTC physicians. This protocol establishes the methodological foundation for developing a robust, evidence-informed expectations of physician commitment that can guide future research, policy development, and quality improvement initiatives in LTC

settings, directly addressing the lack of consensus identified as a key knowledge gap in the field.

Citation

Dash D, Potter M, Siu HYH, Quail P, Katz P, McCarthy LM, Peck S, Tripp D, Costa AP, Rochon P, Savage RD, Jones A, & Stall N. Establishing primary care physician commitment in Canadian long-term care homes: a protocol for a modified e-Delphi study. *BMJ Open*. 2025;15(2):e093277. doi:10.1136/bmjopen-2024-09327

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Protocol

BMJ Open Establishing primary care physician commitment in Canadian long-term care homes: a protocol for a modified e-Delphi study

Darby Dash ¹, Maya Potter,² Henry Yu-Hin Siu,³ Patrick Quail,⁴ Paul Katz,^{5,6} Lisa M McCarthy ^{7,8}, Samantha Peck,⁹ Dee Tripp,¹⁰ Andrew P Costa ^{1,11}, Paula Rochon ^{12,13}, Rachel D Savage ^{12,14}, Aaron Jones ¹, Nathan Stall^{12,15}

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For numbered affiliations see end of article.

Correspondence to
Dr Nathan Stall;
nathan.stall@mail.utoronto.ca

ABSTRACT

Introduction The delivery of medical services by primary care physicians (PCPs) in long-term care (LTC) homes lacks consistency. There is no Canadian standard for PCP commitment in the LTC home setting, which can influence the quality of care delivered and resident health outcomes. The PCP's commitment to LTC practice is theorised as the proportion of a physician's practice dedicated to LTC, the number of residents for whom they provide care and the time spent on individual resident encounters. We aim to establish consensus on expectations concerning PCP commitment in Canadian LTC homes.

Methods and analysis We describe a protocol for a two-round modified e-Delphi study assessing the consensus of an expert panel, guided by the RAND methodological guidance for conducting Delphi panels and the ACCORD Consensus Reporting Document (ACCORD) guideline for healthcare-based consensus studies. We will recruit pan-Canadian experts who demonstrate extensive knowledge and experience in medical care delivery and medical practice models in the Canadian LTC sector. A literature review will generate a candidate list of statements constituting PCP commitment. The first round evaluates the relevance and feasibility of candidate statements through an online questionnaire. Panelists may also write open-ended, qualitative responses to add rationales, suggest alternatives and share new ideas. We will then host a virtual synchronous meeting to have an in-depth discussion about the results from round one. A second questionnaire will be distributed to evaluate the remaining statements that have not reached consensus, and any new statements added based on the same criteria.

Ethics and dissemination The Hamilton Integrated Research Ethics Board (Project ID #17321) approved our study. The findings will be disseminated through manuscripts, presentations, and the lead author's thesis.

Trial registration number The ISRCTN Registry: #35125526.

INTRODUCTION

In Canada, the delivery of medical services in long-term care (LTC) homes varies, with some homes having multiple primary care physicians (PCPs) caring for small numbers

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ Recruitment of frontline long-term care (LTC) primary care physicians (PCPs) from across Canada (with different levels of training, education, career stage, geography, sex, race/ethnicity) with extensive knowledge of medical care provision for LTC residents to gather diverse perspectives on what constitutes PCP commitment.
- ⇒ Candidate statements reflecting PCP commitment will be informed by the published and grey literature to understand the current landscape of PCP commitment, establishing a foundation for a potential Canadian standard.
- ⇒ This study focuses on the perspectives of PCPs and will not include nurse practitioners, given their limited ability to function as the most responsible provider across Canada. Consequently, their perspectives concerning commitment may be excluded from our study.
- ⇒ We will gather and analyse both quantitative data and open-ended responses from the e-Delphi questionnaires, offering detailed explanations and clarifications on the statements for rating.
- ⇒ This study will establish an evidence-informed, robust definition for PCP commitment in LTC, which can have substantial impacts on the LTC sector in research, policy, clinical practice, and on resident and caregiver experiences and outcomes.

of residents, while others choose to have one provider caring for as many as 100 or more residents.^{1 2} While PCP commitment in LTC has been operationalised differently based on a conceptual framework, it is generally defined as the proportion of a PCP's practice dedicated to LTC homes, the number of LTC residents for whom they provide care and the time spent on individual resident encounters.^{3 4} Existing research demonstrates that higher quality care within a LTC home results when fewer dedicated physicians are involved and when they are onsite more frequently.^{5–8}

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Most evidence linking PCP commitment to quality of care originates from the USA and Europe, with no international or Canadian standard or consensus for PCP commitment in the LTC home setting.⁹

Previous research by our team demonstrated that 1527 most responsible physicians (MRPs) provide medical care across 626 LTC homes situated in Canada's most populous Province of Ontario; the MRP is the PCP, who provides medical care, including directing and coordinating the changing care needs and managing treatment and care plans of a resident.^{9–10} Ninety-eight percent of these MRPs are family physicians, and 28% have a certificate of added competence in the care of the elderly (COE), palliative care or emergency medicine.^{9–11} In 2017, we described aspects of physician commitment in Ontario's LTC homes in a population-based study. We reported that a small number (14%) of all MRPs in LTC homes cared for half (50%) of all residents across the province.⁹ In our most recent work, we found the demographic characteristics of this LTC MRP workforce between 2019 and 2021 to be similar to the workforce in 2017, while the practice patterns over the COVID-19 pandemic shifted to a smaller workforce delivering care to fewer residents.¹²

Given the emerging recognition of the importance of physician commitment and the absence of an accepted standard or expectation, consensus-building methods are needed to establish a definition for PCP commitment in Canadian LTC homes. The objective of this study is to establish consensus on expectations concerning PCP commitment in Canadian LTC homes based on an expert panel. We conceptualise commitment as an individual physician's engagement in the medical care of the LTC resident and with the family, the care team, the LTC home and their medical practice in the LTC sector to execute high-quality resident-centred care. The research question is: *what are the consensus-determined elements of expectations for PCP commitment in the LTC setting?* This work will support the measurement of LTC PCP commitment using health administrative data, ultimately allowing for the design and evaluation of strategies to improve practice commitment and quality.

METHODS AND ANALYSIS

Study design

This study uses a modified e-Delphi design to assess the consensus of an expert panel and is not an update of pre-existing guidelines.^{13–15} Consensus-generating methods (ie, the nominal group technique, Delphi or RAND/UCLA Appropriateness Method) are a scientific approach to establishing agreement by deriving evidence through consultation from expert opinion and group consensus where empirical evidence is unavailable.^{16–18} These methods are beneficial for extracting reliable information from the collective knowledge of a group, such as those in the medical profession.¹⁶

The modified Delphi technique is a variation of the traditional Delphi method, which involves a structured,

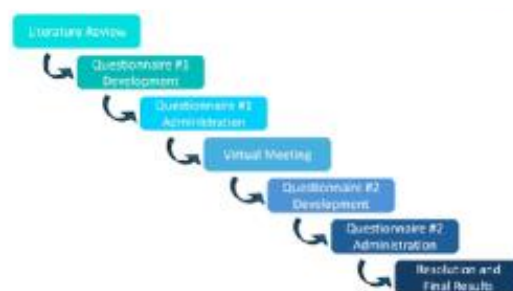


Figure 1 Overview of the modified e-Delphi study.

anonymous communication process among experts and is commonly used in health research.^{13–16–19–21} The modified Delphi technique extends the conventional method by incorporating a meeting among experts between rounds of structured questionnaires. This adaptation facilitates interaction between experts to discuss results and conflicting opinions between rounds.^{18–19} Further, the modified e-Delphi variant provides for the use of virtual electronic platforms for communication and data collection instead of in-person physical meetings, which is particularly helpful with geographically dispersed groups.^{13–15} In our study, we will use the modified e-Delphi technique as a structured, iterative process to collect expert input through a series of rounds until group consensus (defined below) is achieved.^{13–19}

We designed our study using the 2023 RAND methodological guidance for conducting and critically appraising Delphi panels and the ACCurate CONsensus Reporting Document (ACCORD) guideline for healthcare-based consensus studies.^{18–22} An ACCORD guideline checklist for reporting consensus methods can be found in online supplemental file 1, which aided in the reporting of this study protocol.²² The study protocol was prospectively registered with the ISRCTN registry (<https://doi.org/10.1186/ISRCTN35125526>) on 10 July 2024.

Data collection

There are several components to this modified e-Delphi study (figure 1).

Preparation and literature review prior to round one

The preparation stage of the modified e-Delphi study ensures the validity and accuracy of the study by clearly conceptualising the goals and aims, examining existing research and involving experts to support the development of the study.^{17–21} We completed a comparative policy analysis based on the peer-reviewed and grey literature to inform the questionnaire statements (manuscript under preparation). This review clarified what is known and what constitutes PCP commitment in each Canadian province and territory, as well as within 15 countries, like Canada, with above OECD average spending for LTC services. We searched PubMed, Google Scholar and Google from 8 May 2023 to 18 August 2023, with

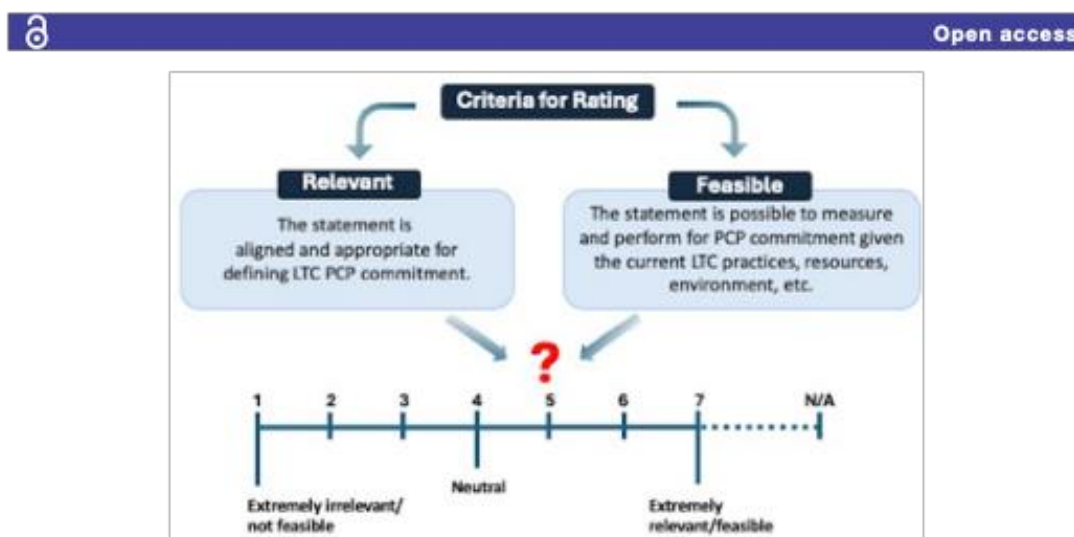


Figure 2 Evaluative criteria for rating primary care physician commitment in Canadian long-term care homes. LTC, long-term care; PCPs, primary care physicians.

an updated search from 30 May 2024 to 1 August 2024, using keywords such as LTC, nursing home, physician, MRP/provider, standards, requirements and country or jurisdiction name. We searched for official ministerial or jurisdictional documents and peer-reviewed material. Using these findings, we generated a candidate list of statements that our expert panel will formally evaluate based on the conceptualisation of commitment. Our review found limited information on PCP commitment through the comparative policy analysis. Despite efforts to search peer-reviewed literature, the lack of information necessitated that most information be obtained from grey literature and resources from national or provincial health authorities or medical association websites. The evidence from the review was not presented to the expert panel to avoid influencing their responses to the modified e-Delphi questionnaires.

Modified e-Delphi round one

In the first round of the modified e-Delphi, an asynchronous questionnaire will be distributed to the expert panel in English to complete independently and anonymously. The anonymous nature of round one prevents dominant voices from influencing the ratings.^{13 16 19} The purpose of the first round is to obtain an initial rating on the expectations of commitment based on our predetermined evaluative criteria of relevance and feasibility (figure 2). 'Relevance' means the statement is aligned and appropriate for defining LTC PCP commitment, while 'feasibility' means the statement is possible to measure and perform for LTC PCP commitment given the current care practices, resources, environments, and data systems. We iteratively drafted the statements for rating to ensure accurate wording and to reduce bias and response variance.¹⁷

All study-related documents will be shared via email, along with a link to provide demographic information and

complete the online round one questionnaire through a secure Research Electronic Data Capture server hosted at McMaster University (Hamilton, Ontario, Canada). We will collect ordinal ratings using a 7-point Likert scale, allowing for granularity in measurement.²³ Ratings will range from 1 (extremely irrelevant or not feasible) to 7 (extremely relevant or feasible). We will also encourage open-ended, qualitative responses, so panellists can add rationales, suggest alternatives and share new ideas.^{17 21} Panel members will complete the first questionnaire within a 3-week period in the Fall of 2024.

Pilot testing will occur with a small group of individuals for readability and comprehension and to ensure the sensibility of the questionnaire logic and programming on the online platform.^{17 18 21} We defined consensus a priori using predetermined thresholds (table 1). Although there is no standard recommendation on defining consensus in a modified e-Delphi study, the most common method is percent agreement.^{16 24}

Table 1 Consensus thresholds	
Inclusion	≥70% of panel members provide a high rating (between 5 and 7) on the Likert scale for each criteria (based on the median score)
Exclusion	≥70% of panel members provide a low rating (between 1 and 3) on the Likert scale for each criteria (based on the median score)
Non-consensus	When the rated statement has not met either the inclusion or exclusion consensus threshold (<70% of the panel)

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Preparation for virtual meeting

After the completion of round one, the steering committee will compile the ratings and qualitative feedback from the expert panel members and share individual and overall anonymised group results with the expert panel. The purpose of this is to allow each panel member to see how their responses compare with the rest of the group, understand areas of agreement and disagreement, and consider the new aspects introduced through the open qualitative responses, all of which facilitate the process of consensus, allow experts to understand the opinions of others and appreciate the time and effort of participating experts.^{16 17} In preparation for round two, the questionnaire will be modified to remove statements that have reached consensus, retain statements without consensus and add new statements for rating from the open-ended responses.¹⁸

Virtual meeting

We will host a meeting with the expert panel in English using virtual telecommunications software, which is a unique feature of the modified e-Delphi design compared with the traditional Delphi method.¹⁹ Since panellists are dispersed across Canada, we opted for a virtual medium to facilitate communication. The purpose of the meeting is to review and have an in-depth discussion about the results from round one, which will provide relevant context. The focus will remain on the statements where consensus was not reached and on adding new statements, which will be elected for rating. The second part of the meeting will discuss the feasibility of measuring commitment in currently available data sources and whether an ideal standard is feasible for Canadian LTC PCPs and the LTC system. The virtual meeting will be co-chaired by investigators DD and NMS/AC.

Modified e-Delphi round two

In round two, a second questionnaire will be distributed to the expert panel in English to evaluate the remaining statements constituting PCP commitment, including the addition of any new statements. Panellists will have 3 weeks to complete the revised questionnaire. Iteration is a key feature of the modified e-Delphi that allows experts to revisit and re-rate the statements in the questionnaire.^{16–18} Similar to round one, we will collect ratings on a 7-point Likert scale for 'relevance' and 'feasibility' with statements endorsed highly (greater than or equal to 70% of the panel) moving to the final list. After the round two ratings are completed, results will be summarised and shared with experts, and the modified e-Delphi study will be terminated.¹⁷

Data analysis

We will analyse the quantitative and qualitative data from the modified e-Delphi process. The demographic characteristics will be summarised using descriptive statistics. For each statement in the questionnaire, we will calculate the median and IQR for each evaluative criterion to showcase

the distribution and the percentage of agreement to quantify consensus.^{17 21 23 25} Given our use of an ordinal Likert scale, we select the median and IQR over the mean and SD.²⁶ We will conduct the Wilcoxon matched-pairs signed-rank test to measure the change in consensus between rounds.²⁶ When comparing results across groups, we will use χ^2 tests or analysis of variance with individual pair-wise comparisons. We will conduct a content analysis of the open-ended qualitative data to identify common patterns or themes.^{17 21} When providing panellists with feedback, we will share both quantitative and qualitative individual responses relative to the rest of the group and summarise all open-ended responses. Data will be analysed after each stage of the modified e-Delphi study. All data will be held at McMaster University (Hamilton, Ontario, Canada), and access will be restricted to the research team.

Sample and eligibility criteria

Given our interest in building consensus on expectations for PCP commitment in LTC, our expert panel will include individuals with knowledge and/or experience on medical care delivery and medical practice models in Canadian LTC based on practical and/or leadership experience, to enhance content validity.^{14 17} We will seek diverse perspectives on the commitment of PCPs across Canada, and therefore, we will include English-speaking frontline LTC PCPs from across the country. We will make every effort to obtain individuals with different levels of training, education, career stages, geography, sex, gender, race and ethnicity. Each expert panel member will be considered equal (equal weighting of responses). Family physicians provide the bulk of medical care delivery in LTC,¹² and we expect them to be the most represented medical specialty on the expert panel. Some family physicians may have a focused practice designation or hold a certificate of added competence in COE. To demonstrate expertise for this study, panellists must be a PCP with at least 2 years of clinical and/or leadership experience in LTC and/or be actively involved in the care of LTC residents.^{18 21}

Recruitment

We will use purposive, criterion and convenience sampling to recruit individuals to our expert panel, as is common in modified e-Delphi studies, and use a multi-pronged approach.^{18 21} We will make direct contact with an initial list of candidates to establish interest and availability. This initial list will be developed based on our previous research collaborations in the sector and knowledge of LTC-focused physicians. Further, panellists will be able to suggest other potential participants at the end of the demographic survey. Our second approach will involve recruiting relevant candidates through the email distribution lists of the Canadian Society for LTC Medicine and the Ontario Long-Term Care Clinicians Association. Candidates will be approached via email by the lead investigator (DD) to describe the study and its methods, the anticipated time commitment and how responses will

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be used. We will recruit up to 30 individuals and expect 15 to 20 individuals to participate in our expert panel.^{27,28} There is no standard recommendation on the optimal panel size for consensus-based studies, with most studies having between 10 and 1000 participants, as it depends on factors such as the nature of the research question, homogeneity/heterogeneity of the panel members, available resources, access to the panel and the format of the study (eg, e-Delphi panels are reported to have lower participation acceptance rates).^{17,18,21,27–29} It is reasonable to expect a smaller sample size when experts have a similar understanding of the topic area and similar training. While there is limited guidance on sample size for modified e-Delphi studies, we anticipate generating adequate data from the diverse perspectives of panellists.^{27,28}

We will use strategies to maximise the response rate (ie, restricting to two-round e-Delphi, sending reminder emails and offering honoraria).¹⁸ Once each stage of the study is completed, emails will be sent to panel members to thank them for their contributions, provide honoraria, share progress, and invite them to the next stage, as relevant to the modified e-Delphi process.

Steering committee

A steering committee (DD, NMS, APC, LM, DT and SP) was formed to guide the conduct and execution of this study and ensure the process is well organised, rigorous and productive in generating insights and consensus among participants. The steering committee's role includes designing the study protocol, developing the e-Delphi questionnaires, recruiting panel members, analysing and interpreting all data collected, and facilitating communication among panel members. The steering committee will not have any voting rights in the e-Delphi questionnaire exercises. Members of the committee were selected based on interest and expertise and consisted of DD, the lead investigator examining physician practices in LTC; APC, an epidemiologist and health services researcher; NMS, a geriatrician and health services researcher; LM, a pharmacist and health services researcher with experience in consensus studies; and DT and SP, who represent the voices of residents and caregivers, respectively.

Patient and public involvement

Our study relies on the expertise of panellists with extensive knowledge of medical care delivery and medical practice models in Canadian LTC. Given our focus on PCPs and their knowledge of priorities in this sector, they were involved in the design and conduct of this research, including the priority of the research question, study design, developing questionnaires and candidate statements, and methods of recruitment. Nurse practitioners have not been included as panel members, given they are slowly gaining a footprint in the Canadian context.³⁰ Very little is known about the practice of LTC nurse practitioners as they do not submit billings for services rendered, instead receiving a direct salary for their services, and functioning primarily as collaborative

members of the care team instead of as PCP. Further, resident/family caregivers have not been included as potential panel members as we anticipate mixing these different stakeholder groups in one expert panel will be ineffective due to perceived or real power imbalances, and to avoid technical discussions on medical professional practice that require explanation. However, they serve as the key stakeholders in receiving the care that PCPs deliver. To represent the voices of LTC residents and caregivers, we have engaged with the Ontario Association of Residents' Councils and Family Councils Ontario to guide the conduct of this study and to aid in developing the candidate statements related to commitment. Leaders of these organisations (DT and SP) are co-authors who provided critical input for this study protocol. We intend to pursue future work that builds on the findings of this physician-focused study to engage nurse practitioners, LTC residents and caregivers. We have chosen to engage in a separate approach given the emerging model of nurse practitioners in LTC and to eliminate technical discussion. This independent approach ensures the inclusion of diverse public perspectives while maximising the feedback of these critical voices with an appropriate study design rather than limiting their involvement in the present study.

ETHICS AND DISSEMINATION

Risks to participants

We did not identify any known or anticipated risks to expert panel members due to their participation in this study. Given that the experts will have relevant professional experience and academic backgrounds, we do not anticipate this being difficult. It is unlikely that this study will cause any psychological distress. Voluntary and informed consent will be obtained electronically from interested candidates before participation in the study, and panellists will be able to voluntarily withdraw themselves and their data from the study at any time for any reason.

Confidentiality and data management

All data provided by experts will be anonymised once collected. Only the research team will have access to the raw data for processing, analysis, and write-up, and the lead investigator (DD) will uphold all data security protocols. The raw data will only be accessed to assign a unique participant ID number, after which all data will only be associated with this participant ID. All information provided will be kept on a computer and data will be protected with encryption and passwords. No participant-level data will be shared with anyone other than the participant themselves, so they can view their individualised feedback in relation to the responses of others. All other data from this study will be presented in aggregate form only. Personal and demographic data will not be available to anyone outside the research team. Once the study has been completed, any identifiable information

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will be deleted, and de-identified data by participant IDs will be kept indefinitely.

Ethics approval

This study was approved by the Hamilton Integrated Research Ethics Board (Project ID #17321).

Results dissemination

Our findings will be shared publicly in academic publications, conference presentations and via a doctoral thesis. Communications on the study's results will be sent to relevant stakeholders (eg, Canadian Society for LTC Medicine, Ontario LTC Clinicians) for distribution. We will report our study findings using the ACCORD methodological guideline for healthcare-based consensus studies.²²

DISCUSSION

This study will establish key foundations for a standard of PCP commitment in Canadian LTC homes, addressing the existing variability and absence of a unified measure of PCP involvement in these settings. The consensus-building methods detailed in this protocol are designed to develop a definition of commitment that is both concept-specific and independent/agnostic of data types (eg, claims data). Using this approach ensures the definition of commitment is broadly applicable and not limited by specific data constraints, which is crucial given the diverse ways in which PCPs engage in the LTC setting worldwide.

A unified definition of commitment will enhance our ability to characterise and quantify PCP involvement in LTC settings more precisely, in the broader context of care delivery in LTC. By operationalising this definition into components, future research can align these components with various data sources, allowing for an analysis of the relationship between PCP commitment and quality of care. This framework can be extended to examine the commitment of other healthcare professionals across different roles and settings, as care is inherently team-based, collaborative and shaped by all team members. Considering a specific PCP and resident ratio is challenging and impacted by many factors worldwide, such as medical care provision models, geography, panel size, practice in other care settings, continuity of care, other available staffing supports and resources, resident complexity, access and availability. By improving our understanding of PCP commitment and its impact on care quality, this research can contribute to policy development to address workforce issues in LTC. Enhancing the quality of care and clarifying the role and value of PCPs within LTC settings could lead to more effective policies and interventions supporting PCPs, other interdisciplinary team members and residents.

The importance of this work is underscored by the ongoing challenges in health human resources

worldwide, within the LTC sector and the larger healthcare system, compounded by a shortage of workers and the impending retirement of many physicians.^{31–36} Many countries face difficulties in retaining healthcare workers, managing the increasing demand and complexity of care due to population ageing, and addressing high levels of burnout and stress among care providers.^{34 35 37–45} Additionally, concerns over the quality and consistency of medical care persist, given that healthcare systems are organised differently across countries and often remain fragmented.^{1 36 46} This has led to growing interest in creating standards and establishing formal competence in practicing LTC medicine.^{34 40 47} Our research on understanding commitment will be valuable not only for post-industrial nations facing these issues but also for developing countries, such as China and India, which are in the process of developing formal LTC systems and addressing key challenges related to standards, staffing, assessment structures, funding models, and licensing and regulatory frameworks.^{42 48–50} Further, our work will offer insights on how to define the role of the physician within a multi-disciplinary team and how to foster greater engagement among healthcare providers.

Our ultimate goal is to provide knowledge users and decision-makers with evidence-based guidance to inform PCP practice in LTC. The anticipated outcomes will provide clear expectations for care processes, advance practice and policy, strengthen relationships within the LTC sector, and support a more cohesive and coordinated approach to resident care. By establishing a robust definition of PCP commitment, this research has the potential to drive significant improvements in care quality and workforce management in LTC settings.

Author affiliations

¹Department of Health Research Methods, Evidence, and Impact, McMaster University Faculty of Health Sciences, Hamilton, Ontario, Canada

²Division of General Internal Medicine and Geriatrics, Sinai Health, Toronto, Ontario, Canada

³Department of Family Medicine, McMaster University, Hamilton, Ontario, Canada

⁴Family Medicine, University of Calgary Cumming School of Medicine, Calgary, Alberta, Canada

⁵Department of Geriatrics, Florida State University College of Medicine, Tallahassee, Florida, USA

⁶Department of Medicine, McMaster University, Hamilton, Ontario, Canada

⁷Institute for Better Health, Trillium Health Partners, Mississauga, Ontario, Canada

⁸University of Toronto Leslie Dan Faculty of Pharmacy, Toronto, Ontario, Canada

⁹Family Councils of Ontario, Toronto, Ontario, Canada

¹⁰Ontario Association of Residents' Councils, Toronto, Ontario, Canada

¹¹Centre for Integrated Care, St Joseph's Health System, Hamilton, Ontario, Canada

¹²Women's Age Lab and Women's College Research Institute, Toronto, Ontario, Canada

¹³University of Toronto Department of Medicine, Toronto, Ontario, Canada

¹⁴University of Toronto Institute of Health Policy Management and Evaluation, Toronto, Ontario, Canada

¹⁵Department of Medicine, University of Toronto, Toronto, Ontario, Canada

X Darly Dash @darstar01, Lisa M McCarthy @pharmacist_lisa, Rachel D Savage @savageira and Aaron Jones @aaronjonesstats

Contributors DD, PK, APC and NS contributed to the study concept. All authors

(DD, MP, HY-HS, PQ, PK, LMM, SP, DT, APC, PR, RDS, AJ, NS) contributed to the

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study design. DD designed the protocol. DD, MP and NS drafted and revised the manuscript. All authors (DD, MP, HY-HS, PQ, PK, LMM, SP, DT, APC, PR, RDS, AJ, NS) provided critical feedback and approved the version to be published. NS is the guarantor.

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ORCID iDs

Daryl Dash <http://orcid.org/0000-0002-1881-5465>
 Lisa M McCarthy <http://orcid.org/0000-0001-9087-1077>
 Andrew P Costa <http://orcid.org/0000-0001-9212-5641>
 Paula Rochon <http://orcid.org/0000-0002-5973-4151>
 Rachel D Savage <http://orcid.org/0000-0002-2746-373X>
 Aaron Jones <http://orcid.org/0000-0002-6282-3614>

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Appendix

Supplemental material

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Supplementary File 1. ACCurate COnsensus Reporting Document (ACCORD) Guideline Checklist for Reporting Consensus Studies¹

Item No.	Section	Checklist Item	Page No.
T1	Title	Identify the article as reporting a consensus exercise and state the consensus methods used in the title. <i>For example, Delphi or nominal group technique.</i>	1
I1	Introduction	Explain why a consensus exercise was chosen over other approaches.	7
I2		State the aim of the consensus exercise, including its intended audience and geographical scope (national, regional, global).	7
I3		If the consensus exercise is an update of an existing document, state why an update is needed, and provide the citation for the original document.	N/A
M1	Methods Registration	If the study or study protocol was prospectively registered, state the registration platform and provide a link. If the exercise was not registered, this should be stated. <i>Recommended to include the date of registration.</i>	8
M2	Selection of SC and/or panellists	Describe the role(s) and areas of expertise or experience of those directing the consensus exercise. <i>For example, whether the project was led by a chair, co-chairs or a steering committee, and, if so, how they were chosen. List their names if appropriate, and whether there were any subgroups for individual steps in the process.</i>	15
M3		Explain the criteria for panellist inclusion and the rationale for panellist numbers. State who was responsible for panellist selection.	13-14
M4		Describe the recruitment process (how panellists were invited to participate). <i>Include communication/advertisement method(s) and locations, numbers of invitations sent, and whether there was centralised oversight of invitations or if panellists were asked/allowed to suggest other members of the panel.</i>	13-14
M5		Describe the role of any members of the public, patients or carers in the different steps of the study.	15
M6	Preparatory research	Describe how information was obtained prior to generating items or other materials used during the consensus exercise. <i>This might include a literature review, interviews, surveys, or another process.</i>	8-9
M7		Describe any systematic literature search in detail, including the search strategy and dates of search or the citation if published already. <i>Provide the details suggested by the reporting guideline PRISMA and the related PRISMA-Search extension.</i>	8-9
M8		Describe how any existing scientific evidence was summarised and if this evidence was provided to the panellists.	8-9
M9	Assessing consensus	Describe the methods used and steps taken to gather panellist input and reach consensus (for example, Delphi, RAND-UCLA, nominal group technique). <i>If modifications were made to the method in its original form, provide a detailed explanation of how the method was adjusted and why this was necessary for the purpose of your consensus-based study.</i>	9-12
M10		Describe how each question or statement was presented and the response options. State whether panellists were able to or required to explain their responses, and whether they could propose new items. <i>Where possible, present the questionnaire or list of statements as supplementary material.</i>	9-10
M11		State the objective of each consensus step. <i>A step could be a consensus meeting, a discussion or interview session, or a Delphi round.</i>	9-12
M12		State the definition of consensus (for example, number, percentage, or categorical rating, such as 'agree' or 'strongly agree') and explain the	10



		rationale for that definition.	
M13		State whether items that met the prespecified definition of consensus were included in any subsequent voting rounds.	10-11
M14		For each step, describe how responses were collected, and whether responses were collected in a group setting or individually.	9-12
M15		Describe how responses were processed and/or synthesised. <i>Include qualitative analyses of free-text responses (for example, thematic, content or cluster analysis) and/or quantitative analytical methods, if used.</i>	12-13
M16		Describe any piloting of the study materials and/or survey instruments. <i>Include how many individuals piloted the study materials, the rationale for the selection of those individuals, any changes made as a result and whether their responses were used in the calculation of the final consensus. If no pilot was conducted, this should be stated.</i>	10
M17		If applicable, describe how feedback was provided to panellists at the end of each consensus step or meeting. <i>State whether feedback was quantitative (for example, approval rates per topic/item) and/or qualitative (for example, comments, or lists of approved items), and whether it was anonymised.</i>	9-12
M18		State whether anonymity was planned in the study design. Explain where and to whom it was applied and what methods were used to guarantee anonymity.	9
M19		State if the steering committee was involved in the decisions made by the consensus panel. <i>For example, whether the steering committee or those managing consensus also had voting rights.</i>	15
M20	Participation	Describe any incentives used to encourage responses or participation in the consensus process. <i>For example, were invitations to participate reiterated, or were participants reimbursed for their time.</i>	14
M21		Describe any adaptations to make the surveys/meetings more accessible. <i>For example, the languages in which the surveys/meetings were conducted and whether translations or plain language summaries were available.</i>	9-12
R1	Results	State when the consensus exercise was conducted. List the date of initiation and the time taken to complete each consensus step, analysis, and any extensions or delays in the analysis.	N/A
R2		Explain any deviations from the study protocol, and why these were necessary. <i>For example, addition of panel members during the exercise, number of consensus steps, stopping criteria; report the step(s) in which this occurred.</i>	N/A
R3		For each step, report quantitative (number of panellists, response rate) and qualitative (relevant socio-demographics) data to describe the participating panellists.	N/A
R4		Report the final outcome of the consensus process as qualitative (for example, aggregated themes from comments) and/or quantitative (for example, summary statistics, score means, medians and/or ranges) data.	N/A
R5		List any items or topics that were modified or removed during the consensus process. Include why and when in the process they were modified or removed.	N/A
D1	Discussion	Discuss the methodological strengths and limitations of the consensus exercise. <i>Include factors that may have impacted the decisions (for example, response rates, representativeness of the panel, potential for feedback during consensus to bias responses, potential impact of any non-anonymised interactions).</i>	N/A
D2		Discuss whether the recommendations are consistent with any pre-existing literature and, if not, propose reasons why this process may have arrived at alternative conclusions.	N/A



O1	Other Information	List any endorsing organisations involved and their role.	20
O2		State any potential conflicts of interests, including among those directing the consensus study and panellists. Describe how conflicts of interest were managed.	20
O3		State any funding received and the role of the funder. <i>Specify, for example, any funder involvement in the study concept/design, participation in the steering committee, conducting the consensus process, funding of any medical writing support. This could be disclosed in the methods or in the relevant transparency section of the manuscript. Where a funder did not play a role in the process or influence the decisions reached, this should be specified.</i>	20

¹ From: PLoS Med 21(1): e1004326. <https://doi.org/10.1371/journal.pmed.1004326> For more information see: <https://www.ismpp.org/accord>

CHAPTER FOUR

A Framework for Expectations of Physician Commitment in Long-Term Care Homes:

A Consensus Statement

Summary

This chapter presents the results of the consensus study described in Chapter 3. This study built the first consensus-based framework on expectations of LTC physician commitment with 27 expert LTC physicians from across Canada. In this study, we achieved exceptional participation rates and consulted experts to evaluate 38 statements in two rounds employing both quantitative consensus thresholds and rich qualitative feedback. Through this comprehensive process, the expert panel reached consensus on 21 statements that define a multidimensional framework on expectations for physician commitment, encompassing time allocation, in-person presence, interdisciplinary collaboration, clinical care approaches, accessibility to staff, and ongoing competency development.

This study makes several novel contributions to the field. It establishes the first consensus-based, data-agnostic framework for physician commitment in LTC that moves beyond traditional billing-based measures to capture the true complexity of physician engagement. The framework provides clear, evidence-informed expectations that can guide medical education curricula, inform workforce planning and recruitment strategies, support policy development for funding models, and establish foundations for meaningful quality measurement. By demonstrating that commitment encompasses far more than practice proportions, the study validates the need for more nuanced approaches to understanding and measuring physician involvement in LTC settings.

Citation

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Abstract

Objective: To establish consensus-guided expectations for primary care physician (PCP) commitment in Canadian long-term care (LTC) homes, developing a comprehensive framework for this multifaceted concept.

Design: Two-round modified e-Delphi study with a virtual consensus meeting between rounds.

Setting and Participants: Twenty-seven Canadian LTC PCPs as expert panelists (63% female, median age 54 years, median 15 years LTC experience).

Methods: Panel members rated 38 candidate statements on relevance and feasibility using a 7-point scale, providing qualitative feedback in an online questionnaire. Consensus was defined a priori as $\geq 70\%$ of panelists rating a statement in a particular direction. Non-consensus statements in round one were revised and re-evaluated in round two following the virtual meeting (Study registration number: ISRCTN35125526).

Results: In round one, 18 statements were endorsed as relevant and feasible expectations for PCP commitment. Following the virtual meeting, 22 statements were rated in round two, yielding three additional consensus statements. The final 21 endorsed statements encompassed: time allocated in LTC, in-person visits and on-site presence, number of residents cared for, assessments and care conferences, interdisciplinary collaboration, accessibility of PCP to staff, emphasis on medical care approaches for medication management and palliative care principles, and ongoing competency development. The panel did not endorse statements focused on the

number of LTC homes a PCP serves, cumulative experience, specialized certifications, clinical leadership, or research activities as essential to commitment.

Conclusions and Implications: This first consensus-based framework for PCP commitment in Canadian LTC provides a clear, evidence-informed, multidimensional understanding, enhancing our ability to characterize and quantify physician involvement in LTC. This framework is crucial for enhancing care quality in the LTC sector, guiding policies and practices, influencing minimum care standards, and addressing health human resources while supporting future research linking PCP commitment to resident health outcomes and developing measurement tools to assess physician commitment in LTC.

Introduction

The complexity of delivering healthcare in long-term care settings (LTC, also referred to as nursing homes, personal care homes, or residential aged care) presents challenges for primary care physicians (PCPs) worldwide who serve medically complex and vulnerable residents.^{1,2} PCPs comprise family physicians or general practitioners, and play key roles in providing organized, competent, and high-quality medical care for LTC residents.³ However, there is an absence of standardized expectations regarding their commitment to LTC practice.^{4,5} This issue is compounded by residents' increasing medical complexity due to polypharmacy, multimorbidity, frailty, cognitive and functional impairment, alongside workforce shortages in the sector.^{1,6–16}

Physician commitment has been recognized as one of three core components of high-quality medical care in LTC homes, alongside competence and medical staff organization.^{17,18} Together, this triad forms the basis of the Nursing Home Specialist Model, which posits that physicians who are competent, working within an organized model within the facility, and consistently involved, i.e., committed, are best positioned to deliver high-quality, coordinated care.^{17,18} Physician commitment in LTC is commonly conceptualized based on the proportion of a physician's practice dedicated to LTC, the number of residents cared for, and time spent in LTC medical care.¹⁷ However, commitment is multifactorial and may include other elements, such as continuity of care, accessibility, and integration with the care team, among others.^{5,19} The existing conceptualization lacks a consensus standard from experts working within the Canadian and international LTC contexts to guide expectations for physician involvement.^{3,4} The absence of clear and uniform expectations impedes important

functions within the LTC continuum. First, it creates ambiguity for physicians entering LTC practice regarding reasonable expectations and workload. Second, it limits our ability to measure and compare physician involvement/practice patterns in a meaningful way, which impedes the ability to explore and assess quality outcomes. Third, it complicates workforce planning and policy development aimed at ensuring adequate medical care coverage for LTC residents across diverse geographical areas and practice contexts.

The lack of expectations on PCP commitment in LTC is concerning, given emerging evidence linking physician practice patterns to quality of care outcomes and resident well-being.^{20–31} In Canada, most PCPs in LTC homes are family physicians providing ongoing medical care, with some holding additional certifications in care of the elderly, or palliative care, and most work across multiple practice settings.^{3,32–35} Population-based studies in the province of Ontario revealed significant variations in physician practice patterns, with a small proportion (14%) of PCPs caring for half of all LTC residents across the province.³ Recent data demonstrate further shifts towards a smaller workforce caring for fewer LTC residents, emphasizing the dynamic nature of physician involvement.³⁶ In other countries worldwide, physician care in LTC is similarly provided by PCPs or a limited number of specialties. For example, general practitioners serve LTC in the United Kingdom, and internal medicine and family medicine physicians deliver the most LTC in the United States.^{19,37} This suggests that worldwide, the concentration of medical care remains with PCPs who are not exclusively focused on LTC. While PCPs may remain committed and competent in delivering primary care to LTC residents, the complexity of LTC demands expertise and ongoing training to ensure

high-quality care. This underscores the importance of training and continuing professional development tailored to LTC.³⁸ Furthermore, there are global concerns about the consistency and quality of medical care in LTC.^{16,18,19,39–41}

To address the knowledge gap surrounding PCP commitment, we conducted a modified e-Delphi study engaging expert PCPs working in Canadian LTC to establish consensus on expectations for PCP commitment in LTC settings. Our research question was: *what are the consensus-determined elements of expectations for PCP commitment in the LTC setting?* Through a structured consensus-building process, we aimed to develop evidence-informed expectations of PCP commitment that reflect the complexities of Canadian LTC practice while establishing clear expectations to inform future research, education, and policy.

Methods

Design

We conducted a two-round modified e-Delphi study from October 2024 to January 2025, in accordance with our previously described study protocol.⁴ This consensus-building approach combined anonymous questionnaires with a facilitated virtual discussion between rounds.^{42,43} We designed our study using the RAND methodological guidance for conducting Delphi panels and adhered to the ACcurate COnsensus Reporting Document (ACCORD) guidelines in designing and reporting our study.^{42,44}

Setting

This study was set across Canada, where physicians deliver medical care to long-stay LTC residents under provincially and territorially administered, but publicly

funded programs. As of 2021, there were over 198,000 LTC beds distributed across 2,076 LTC homes nationwide.⁴⁵ LTC homes in Canada do not provide post-acute care and instead focus on long-stay residential settings, often serving as a terminal destination for residents.

Registration and Ethics Approval

Our study was approved by the Hamilton Integrated Research Ethics Board (Project ID #17321) and prospectively registered with ISRCTN ([#35125526](#)). All panel members provided electronic written consent before participation.

Recruitment of Expert Panel Members

In brief, from our protocol, we invited PCPs with knowledge and/or experience in medical care delivery and practice models in Canadian LTC, with at least two years of LTC clinical and/or leadership experience and active involvement in resident care. We aimed to recruit up to 30 PCPs. Recruitment occurred in October 2024 through direct contact with potential panel members and via email distribution lists of The Canadian Society for LTC Medicine (approximately 400 members across Canada) and the Ontario Long-Term Care Clinicians (approximately 300 members across Canada). Email distribution lists were primarily composed of physicians, but may have also included other clinicians, non-clinicians, and individuals in administrative and leadership roles. Prospective panel members reviewed our information letter, provided informed consent, and completed a demographic survey about their LTC practice.

Data Collection

Round One Questionnaire: Using a candidate list of statements developed by the research team based on a literature review,⁵ panel members completed the first

questionnaire over three weeks from October to November 2024. The questionnaire included 38 candidate statements to be rated on two evaluative criteria: relevance (aligned and appropriate for defining LTC PCP commitment) and feasibility (to measure and perform given current practices, resources, environments, and data systems) (Supplemental Table 1). Ratings were assigned using a seven-point Likert scale ranging from 1 (extremely irrelevant/not feasible) to 7 (extremely relevant/feasible), with opportunities for qualitative feedback.

Consensus was defined *a priori* as 70% or more of panel members providing a high rating (5-7) for inclusion or a low rating (1-3) for exclusion on both criteria separately. Statements that did not reach this threshold were retained for further consideration in round two. All study data were managed through a secure Research Electronic Data Capture (REDCap) server hosted at McMaster University.^{46,47} A small group (4) of LTC physicians and PhD-level trainees pilot-tested all materials for questionnaire logic, programming, readability, and comprehension. These individuals were not panelists, and their responses were not used in the study results.

Virtual Panel Meeting: Following round one, we provided panel members with a summary workbook containing anonymized quantitative results and qualitative comments. In November 2024, we held one-hour virtual meetings facilitated by DD and NMS to discuss statements that had not reached consensus. We offered three separate meeting times to maximize participation, with each panelist only attending one of the three sessions.

Round Two Questionnaire: The second questionnaire was distributed in December 2024, where we provided a summary of round one results and the virtual

meeting discussion. The rating process followed the same format as round one, with panel members having three weeks to complete their evaluation. Our final list of statements concerning PCP commitment in LTC included those for which 70% or more of the panel rated the statement between 5 and 7 on both evaluative criteria.

Analyses

We summarized the demographic characteristics of panel members using descriptive statistics. For each statement, we calculated the median score, interquartile range, and percentage of panel members providing high or low ratings for both evaluative criteria. Qualitative comments were analyzed using content analysis to identify rationales underlying the quantitative ratings and were used to revise statements and share feedback with participants. We compared results across rounds using the Wilcoxon matched-pairs signed-rank test to measure changes in consensus for similar statements.

Results

Expert Panel Composition

Forty physicians reached out to express interest in study participation via e-mail, of which 32 provided consent. Twenty-seven panel members completed the round one questionnaire and were invited to subsequent study steps. The participation rate for the virtual panel meeting was 93% (25/27), and for round two, 100% (27/27). Figure 1 shows the flow of participants and statements through all stages.

Table 1 illustrates the demographic characteristics of the expert panel. Panelists had a median age of 54 years (IQR=21.5), with 63% being female (n=17). Most were from Ontario (n=23; 85%), with others representing the western Canadian provinces of

Alberta and British Columbia. Most physicians (81.5%) practiced in urban areas, and all used some English language in their LTC practice. All panel members were licensed physicians; eight (30%) held Care of the Elderly Certificates of Added Competence (CAC), while three (11%) had Palliative Care CACs. One-third of panelists possessed additional Master's level training or higher (n=9; 33%). Panel members worked in a median of two LTC homes (IQR=1), caring for a median of 65 LTC residents (IQR=94), with a median of 15 years (IQR=17) of experience working with LTC residents.

Round One Questionnaire

Panel members rated 38 statements, with median scores ranging from 4.0 to 7.0 for both relevance and feasibility (Supplemental Table 1). Based on our pre-determined consensus threshold, 18 statements reached consensus as relevant and feasible. The remaining 20 statements advanced for further evaluation (Figure 1).

The qualitative responses provided insights into the panelists' ratings. For example, panel members indicated that time allocated to LTC and the number of LTC residents a PCP is directly responsible for (Statements #3 and 5) were more reflective of commitment than the proportion of total clinical practice or billings (Statements #1 and 2), which do not account for LTC resident complexity. As one participant noted,

“Using the proportion of the clinical practice based on individuals cared for, does not adequately describe the commitment to LTC. For example, my own LTC practice is only 56 patients out of 1125 and yet this 5% [of LTC residents] takes up 20% of my work week.” (Statement #1, Participant #6).

Participants emphasized that in-person visits (Statement #6) were the “*best way to develop a therapeutic alliance*” (Participant #15) with the residents, families, and the care team, noting there was a “*limited role for virtual care*” (Participant #25) in this setting. While remote clinical activities (Statement #9) were acknowledged as part of

their responsibilities, panelists cautioned against these becoming “*the default mode of care*” (Participant #10). Panel members felt care conferences (Statements #25, 26, and 27) were valuable, but did not find that in-person attendance was always feasible due to scheduling constraints. Participants emphasized that PCP involvement was especially important during changes in a resident’s medical status, as their “*presence and input really has weight with family and residents*” (Statement #27, Participant #23).

Panel members identified medication management (Statements #15 and 16) and a palliative approach to care (Statements #17, 18, and 19) as core components of PCP commitment to LTC practice. They also underscored the importance of interdisciplinary collaboration:

“The PCP is truly in charge but, in reality, not in control. Fostering an environment where all staff are respected and included in the team allows for great team building while raising the standards of care. (Statement #7, Participant #24)

Virtual Panel Meeting

During the virtual meetings, panel members discussed the 20 statements that had not reached consensus and provided feedback on rewording for clarity. Eight panel members attended the first meeting, nine in the second meeting, and eight in the third meeting. Two panel members were unable to attend the virtual panel meeting due to scheduling conflicts. Two statements (Statements #23 and 30) were unanimously dropped as they were considered unclear, vague, or duplicative. The language was revised in two statements (Statements #8 and 12), and three statements were divided into individual concepts (Statements #10, 21, and 38), resulting in seven statements. These revisions were incorporated into the round two questionnaire.

The discussion offered further insight into panelists' perspectives. For example, while panelists agreed that PCP communication with residents/family members was important at certain times (Statement #8), they noted that other frontline team members should maintain regular contact and engagement. Similarly, panel members endorsed in-person assessments upon admission and during significant changes in a resident's condition (Statements #20 and 22) but expressed concerns about annual reviews and physical examinations (Statement #21), noting that residents are already frequently monitored in LTC homes, which is different from primary care in the community. All panel members received a summary of key discussion points to review when completing the round two questionnaire.

Round Two Questionnaire

Panel members rated 22 statements in the second questionnaire, with median scores ranging from 2.0 to 7.0 for relevance and 3.0 to 6.0 for feasibility (Supplemental Table 1). Three additional statements met our consensus threshold and were added to the final set (Statements #10a, 21a, and 26). The other 19 statements did not reach consensus (Figure 1). The Wilcoxon matched-pairs signed-rank test showed significant differences in consensus scores between rounds for the same statements ($p < 0.0001$ for relevance; $p = 0.0033$ for feasibility; Supplemental Figure 1).

The open-ended comments from our final questionnaire provided additional context. For example, being accessible to staff, but not necessarily to residents and/or caregivers, for non-emergent situations was considered to reflect commitment (Statements #10a and b), especially considering feasibility constraints:

“For the staff, there are often times that they will send emails about general things happening in the LTC home or provide updates, so it is important to be

available and accessible. For the residents, this should be done on regular round[ing] days for non-emergency situations. (Statements #10a and b, Participant #7)

Participants explained their preferences for annual reviews over the annual history and physical:

“Annual review is better than annual physical as the focus on a checklist takes away from assessing and discussing what matters for LTC residents and their caregivers. (Statements #21a and b, Participant #28)

Panel members did not consider the number of LTC homes in which a PCP practices (Statement #29) to be indicative of commitment, as this may reflect “*career choices, availability, location, and size of home*” (Participant #14). While ongoing competency in LTC medicine was considered to reflect commitment (Statement #33), added designations, certifications, and Medical Director positions (Statements #31 and 32), were considered helpful but not necessary as the “*absence thereof does not suggest lack of commitment*” (Participant #15). Similarly, more years of LTC practice and residents cared for (Statements #34 and 35) do not indicate that those with less experience are not committed. Finally, activities such as clinical leadership, quality improvement, research, and medical education in LTC were all considered to be above and beyond and not reflective of core commitment to LTC medical practice (Statements #36, 37, and 38a-c).

The final consensus-determined elements of expectations for PCP commitment in LTC included 21 statements (Table 2). Statements that were not agreed upon in the final framework are listed in Table 3. Across all statements, panel members emphasized that while relevance was generally accepted, feasibility varied considerably based on practice environments, resources, billing systems, and available data structures.

Discussion

Our modified e-Delphi study established consensus on 21 statements that define expectations for PCP commitment in Canadian LTC settings. The rigorous two-round process involved 27 expert LTC physicians who characterized commitment beyond traditional metrics such as proportion of practice dedicated to LTC practice or billing percentages. The final framework encompasses multiple dimensions of commitment, including time allocated in LTC, in-person medical visits and on-site LTC home presence, number of residents cared for, assessments and care conferences, interdisciplinary collaboration, the PCP being accessible to staff, emphasis on medical care approaches that focus on medication management and a palliative approach to care, and ongoing competency development in LTC practice. While developed within the Canadian context, this framework addresses physician commitment challenges common across international LTC systems, potentially informing similar consensus-building efforts in other countries with comparable primary-care-based LTC models.

To our knowledge, our study is the first of its kind to provide a multidimensional framework for understanding physician commitment that is not limited by data constraints. Physician commitment is one of the three foundational elements of the Nursing Home Specialist Model.^{17,18} This model links physician practice to quality of care in LTC, emphasizing that commitment encompasses involvement, continuity, responsiveness, and integration with the care team. While prior studies have used conventional measures, such as billing proportions (e.g., the SNFist model) or clinical practice proportions and linked them to resident outcomes,^{20–24,48} they do not provide a comprehensive and nuanced understanding of PCP commitment. The expert panel emphasized that commitment is complex, involving not only time spent but how a PCP

distributes their professional attention across various aspects of care. For instance, participants noted that a LTC practice might comprise a small proportion of the total number of patients they care for (e.g., “5% of all patients”) while requiring a disproportionate time commitment (e.g., “20% of work week”) due to the complexity of care required. This distinction is critical, as commitment to LTC practice often requires substantial time investment despite representing a small portion of a PCP’s overall practice size. The expert panel further emphasized that this discrepancy is inadequately accounted for in many remuneration models. Moreover, our consensus-determined elements highlight the nuanced understanding of commitment that includes a careful balance between in-person and remote care, while maintaining the relational aspects of commitment that extend beyond direct care to include meaningful engagement with the broader interdisciplinary care team.

While our consensus statements provide clear conceptual direction, many elements require the development of specific measurement tools beyond traditional administrative data. Future research should establish how to operationalize our framework using specific data sources, create validated instruments to assess these multidimensional aspects of commitment, and consider variations in practice environments. Operationalizing non-administrative elements could involve structured peer review for assessing interdisciplinary collaboration, instruments to measure the implementation of palliative care approaches, standardized metrics for staff accessibility, and competency assessments of LTC-specific learning activities to capture ongoing professional development.

A clearer understanding of expectations for PCPs in LTC can be valuable for several reasons, particularly considering the ongoing health human resource shortage in the LTC sector.^{1,9–12,14} The framework can inform educational curricula by shaping training programs for medical students, residents, and practicing physicians. It highlights key content and learning areas, such as polypharmacy and palliative care, to which educators should ensure learners are exposed. This work also highlights the importance of ensuring a sense of ongoing continuity of care in the LTC experience for learners. Lastly, intentional curricula design could address hidden curriculum barriers often stemming from negative perceptions of older-adult focused practice.^{49–56} The results of this work can support novel targeted assessment strategies to foster the development of essential skills in LTC (e.g., communication and collaboration). The framework also provides clear expectations for physicians pursuing LTC-based practice, potentially aiding recruitment and retention. Additionally, it can guide healthcare administrators and policymakers in developing funding models and organizational structures that support essential components of PCP commitment. Finally, it establishes a foundation for developing meaningful metrics to assess physician commitment, enabling deeper exploration of the relationship between commitment and quality of care outcomes. This is especially timely given the growing global focus on medical care standards, the development of core competencies for medical care providers in LTC, and the impact on quality in LTC.^{16,18,19,39–41}.

Limitations

Our study focused exclusively on PCPs, excluding nurse practitioners who are gradually becoming more integrated into Canadian LTC practice.⁵⁷ This decision was

intentional given our research question and the limited information available on nurse practitioners' practice patterns. Additionally, our panel did not include LTC residents, caregivers, or other interdisciplinary LTC staff who likely have different perspectives on PCP commitment based on their experiences. Future research should explore commitment expectations from these important stakeholder groups.

Our multidimensional framework, while comprehensive, presents measurement challenges compared to simpler metrics using billing proportion. However, this complexity likely reflects the genuine multifaceted nature of physician commitment in LTC settings, suggesting reductive measures may inadequately capture meaningful engagement.

Importantly, our findings must be interpreted within the context of Canada's decentralized healthcare delivery system, which is characterized by substantial regional variation.⁵ While such variation facilitates flexible and locally tailored care models, it also leads to heterogeneous funding structures and different administrative frameworks across jurisdictions. To capture this diversity, we endeavoured to recruit a geographically representative panel encompassing multiple regions of the country. In the end, we had a large panel of highly engaged participants, with the greatest representation from Ontario, the most populous province, followed by a small number of participants from Western Canada, and none from Eastern Canada and the Territories, which skews our sample towards Ontario. While the characteristics of our study sample align with available workforce data from Ontario, Canada,³⁶ it is unclear how well they reflect the broader national LTC physician population. Our panel was also highly qualified with certifications and additional training, and it is unknown if this represents

the general PCP workforce in LTC. The self-selection of participants likely introduced some degree of sampling bias, and as such, the generalizability of our findings nationally and to more rural, remote, or demographically different regions may be limited. Two panellists were unable to attend the virtual meeting, which we mitigated by providing summary notes from the discussion. Future studies should investigate whether and how PCP commitment varies in other parts of Canada and internationally, where legislative priorities and funding structures may differ, to gain a deeper understanding of the multifaceted nature of PCP commitment in LTC. This would support parallel efforts such as the development of the Canadian National LTC Services Standard and medical care standards worldwide.^{16,40,58,59}

Conclusions

This study addresses a critical gap in the Canadian healthcare system by establishing the first consensus-based framework for expectations of PCP commitment in LTC settings, advancing our understanding of physician involvement in this complex care environment. By identifying 21 statements that characterize commitment, we provide a multidimensional perspective that encompasses time allocation, care practices, team collaboration, physical presence, medical care approaches, and competency development. As the LTC sector continues to face workforce challenges and increasing resident complexity, this framework offers valuable guidance for medical education programs, LTC home operations, physician recruitment and retention strategies, and health policy development. Ultimately, these findings provide an important foundation for establishing standards of PCP commitment in LTC homes that

can support efforts to improve medical care quality for this vulnerable population both within Canada and in similar healthcare systems internationally.

Tables and Figures

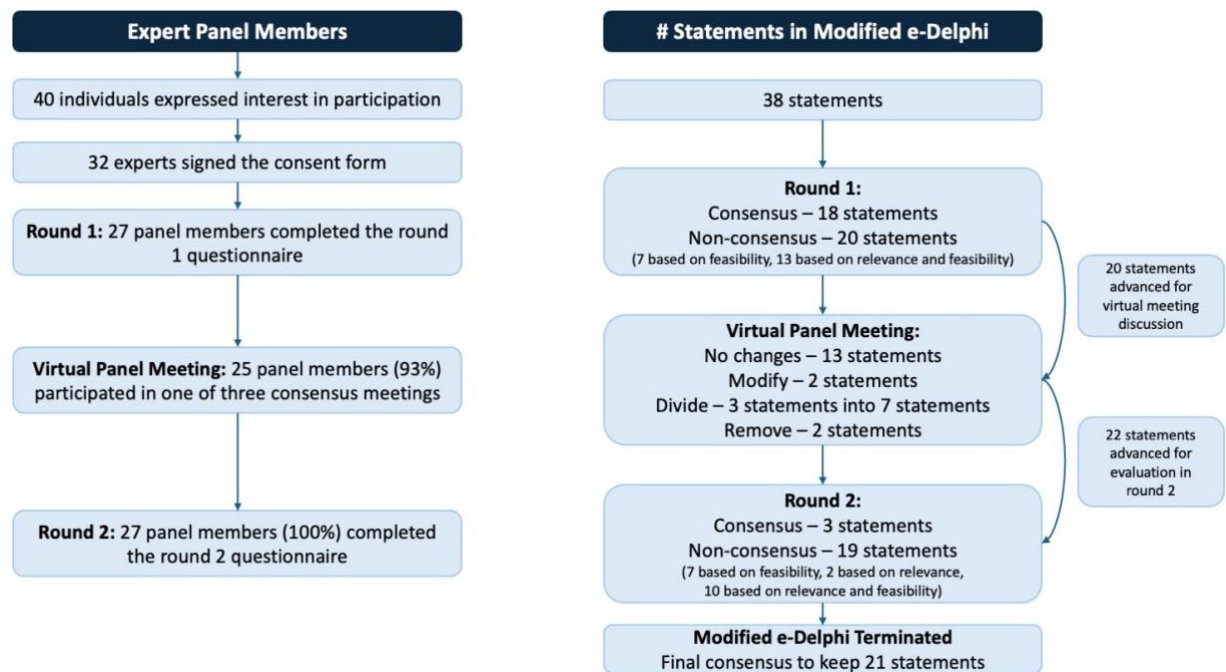


Figure 1. Flow of participants and statements through the study

Table 1. Modified e-Delphi Panel Characteristics

Characteristic	Panelists N = 27
Age, median years (IQR)	54 (21.5)
Gender, no. (%)	
Man	10 (37.0)
Woman	17 (63.0)
Ethnicity, no. (%)	
White	19 (70.4)
Asian	6 (22.2)
Other	2 (7.4)
Province of employment, no. (%)	
Ontario	23 (85.2)
Alberta	2 (7.4)
British Columbia	2 (7.4)
Geography of practice, no. (%)*	
Urban	22 (81.5)
Rural	6 (22.2)
Medical and Graduate Background, no. (%)*	
MD/MbChB	27 (100)
CCFP	25 (92.6)
FCFP and MCFP	6 (22.2)
CAC – Care of the Elderly	8 (29.6)
CAC – Palliative Care	3 (11.1)
Master's level training or higher	9 (33.3)
Language used in LTC practice, no. (%)*	
English	27 (100)
Other	5 (18.5)
Number of LTC homes working in, median (IQR)	2 (1)
Number of LTC residents cared for as PCP, median (IQR)	65 (94)
Years of experience working with LTC residents, median (IQR)	15 (17)
Years involved in LTC research, median (IQR)	0 (3)

*More than one response option could be selected, totals do not add up to N

MD, medical doctor; MbChB, Bachelor of Medicine, Bachelor of Surgery; CCFP, Certification in the College of Family Physicians; FCFP, Fellowship in the College of Family Physicians; CAC, Certificates of Added Competence; LTC, long-term care; PCP, primary care provider

Table 2. Final consensus-determined elements of expectations for LTC PCP Commitment

#*	Statement
3	The number of LTC residents for which a primary care provider is the most responsible provider
5	The time allocated to routine LTC resident care (for direct and indirect care)
6	In-person visits (routine) for an individual LTC resident a PCP is the most responsible provider
7	Participates with the interdisciplinary care team activities in LTC (e.g., with staff/care team, rounds, building and evaluating care plans, etc.)
9	Engaging in remote clinical care activities for indirect LTC resident care
10a	Being accessible and available to communicate with staff by phone or e-mail for non-emergency situations
11	Participates in providing on-call coverage that ensures 24/7 access to care for LTC residents
14	Maintaining LTC medical records on residents with charting and documentation (including remote charting)
15	Conducting LTC medication management within mandated reviews
16	Conducting LTC medication management beyond mandated reviews or ad-hoc (e.g., re-assessing psychotropic medications, reconciliation after hospitalization or other health care contact, etc.)
17	Providing palliative care for chronic medical conditions and other serious illnesses for LTC residents
18	Providing end-of-life care in the last weeks of life for LTC residents
19	Certifying the death of residents within the LTC home, as needed
20	Conducting in-person comprehensive admission assessments of LTC residents (including history, physical, and medication review)
21a	Conducting in-person annual reviews of LTC residents
22	Conducting in-person assessments for a significant change in a LTC resident's physical or mental condition requiring a new evaluation, medication, or other therapeutic intervention
24	Assessing LTC residents after emergency department visits, hospitalizations, and other external healthcare contact
26	Attending care conferences remotely for LTC practice
27	Attending care conferences when the team determines a LTC resident's medical needs as being unique, requiring special assessment, treatment, or change in treatment plan
28	Having on-site presence in the LTC home(s) (physical presence)
33	Ongoing competency development focusing on clinical skills and expertise in LTC practice (e.g., Continuing medical education [CME], credentialing)

*Numbers do not reflect order of importance, but numbering for identification purposes during data collection;

LTC, long-term care; PCP, primary care provider; CME, continuing medical education

Table 3. Statements not achieving consensus for LTC PCP Commitment

#*	Statement
1	The proportion of a primary care provider's total clinical practice that is dedicated to LTC residents, based on all individuals cared for in a given year
2	The proportion of a primary care provider's clinical billings that are earned from LTC practice, based on total billings in a given year
4	The total number of LTC residents for whom a primary care provider provides any care for (e.g., including most responsible, episodic care, on-call, consulting, covering other physicians, etc.)
8	Communicating with the family/caregivers and substitute decision-makers of LTC residents
8a	REVISED: Communicating with the family/caregivers and substitute decision-makers of LTC residents (outside of mandated admission meetings or care conferences).
10	Being accessible and available to communicate with staff, residents, and/or caregivers by phone or e-mail for non-emergency situations
10b	REVISED: Being accessible and available to communicate with residents, and/or caregivers by phone or e-mail for non-emergency situations
12	Working together as a team and in collegiality with other primary care physicians working within the LTC home
12a	REVISED: Working together in medical staff meetings (with NPs where available) to discuss issues related to site policy/operations and medical practice.
13	Providing any LTC medical services when urgently needed for LTC residents of other attending physicians who are not available
21	Conducting in-person annual reviews/history and physicals of LTC residents
21b	REVISED: Conducting in-person history & physicals of LTC residents
23	DROPPED: Participating in medical case rounds to assess LTC resident care and provide medical care as required
25	Attending care conferences in-person for LTC practice
29	The number of LTC homes in which a primary care provider practices
30	DROPPED: Commuting (time and distance) to the LTC home(s) in which a primary care provider practices
31	Having additional practice designation and competence (e.g., Certificate in Added Competency such as Care of the Elderly, Palliative, Focused practice designation, Geriatrician specialty)
32	Being a Medical Director in LTC
34	Years of service towards LTC practice
35	Cumulative LTC residents cared for over career lifetime

36	Advising, participating, and holding meetings with the LTC home as required (e.g., in-service education programs, working with administrative staff to discuss concerns relating to the care of residents)
37	Clinical leadership activities (e.g., monitoring and evaluating medical services, clinical policies and procedures, and/or participating on relevant committees, etc.)
38	Actively participating in quality improvement (QI), research, medical education, and/or scholarship in LTC
38a	REVISED: Actively participating in quality improvement (QI) in LTC
38b	REVISED: Actively participating in research in LTC
38c	REVISED: Actively participating in medical education in LTC

*Numbers do not reflect order of importance, but numbering for identification purposes during data collection; LTC, long-term care; NP, nurse practitioner; QI, quality improvement

Appendices

Supplemental Table 1. Summary of round one and two ratings.

#	Statement	Round one					Round 2				
		Relevance		Feasibility		Result on consensus	Relevance		Feasibility		Result on consensus
		Median	IQR	Median	IQR		Median	IQR	Median	IQR	
1	The proportion of a primary care provider's total clinical practice that is dedicated to LTC residents, based on all individuals cared for in a given year	5	2.5	5	2	Not reached; <70% on both	4	2.5	6	1	Not reached; <70% on one
2	The proportion of a primary care provider's clinical billings that are earned from LTC practice, based on total billings in a given year	5	3	6	3	Not reached; <70% on both	2	2.5	6	2.5	Not reached; <70% on both
3	The number of LTC residents for which a primary care provider is the most responsible provider (MRP)	6	2	7	1	Reached; ≥70% on both	–	–	–	–	–
4	The total number of LTC residents for whom a primary care provider provides any care for (e.g., including most responsible, episodic care, on-call, consulting, covering other physicians, etc.)	5	2.5	5	2	Not reached; <70% on both	5	3	5	3	Not reached; <70% on both
5	The time allocated to routine LTC resident care (for direct and indirect care)	7	1	6	2	Reached; ≥70% on both	–	–	–	–	–
6	In-person visits (routine) for an individual LTC resident a PCP as the most responsible provider	7	1	6	2	Reached; ≥70% on both	–	–	–	–	–

#	Statement	Round one					Round 2				
		Relevance		Feasibility		Result on consensus	Relevance		Feasibility		Result on consensus
		Median	IQR	Median	IQR		Median	IQR	Median	IQR	
7	Participates with the interdisciplinary care team activities in LTC (e.g., with staff/care team, rounds, building and evaluating care plans, etc.)	7	1	5	2	Reached; $\geq 70\%$ on both	–	–	–	–	–
8	Communicating with the family/caregivers and substitute decision-makers of LTC residents	7	1	5	3.5	Not reached; $< 70\%$ on one	–	–	–	–	–
8a	REVISED: Communicating with the family/caregivers and substitute decision-makers of LTC residents (outside of mandated admission meetings or care conferences).	–	–	–	–	–	6	1	4	3	Not reached; $< 70\%$ on one
9	Engaging in remote clinical care activities for indirect LTC resident care	7	1.5	5	1.5	Reached; $\geq 70\%$ on both	–	–	–	–	–
10	Being accessible and available to communicate with staff, residents, and/or caregivers by phone or e-mail for non-emergency situations	7	1	5	4	Not reached; $< 70\%$ on one	–	–	–	–	–
10a	REVISED: Being accessible and available to communicate with staff by phone or e-mail for non-emergency situations	–	–	–	–	–	7	1	6	2	Reached; $\geq 70\%$ on both

#	Statement	Round one					Round 2				
		Relevance		Feasibility		Result on consensus	Relevance		Feasibility		Result on consensus
		Median	IQR	Median	IQR		Median	IQR	Median	IQR	
10b	REVISED: Being accessible and available to communicate with residents, and/or caregivers by phone or e-mail for non-emergency situations	–	–	–	–	–	5	3.5	3	3	Not reached; <70% on both
11	Participates in providing on-call coverage that ensures 24/7 access to care for LTC residents	7	0.5	7	2	Reached; ≥70% on both	–	–	–	–	–
12	Working together as a team and in collegiality with other primary care physicians working within the LTC home	7	1	5	3	Not reached; <70% on one	–	–	–	–	–
12a	REVISED: Working together in medical staff meetings (with NPs where available) to discuss issues related to site policy/operations and medical practice.	–	–	–	–	–	6	1.5	5	2.5	Not reached; <70% on one
13	Providing any LTC medical services when urgently needed for LTC residents of other attending physicians who are not available	6	1	5	2	Not reached; <70% on one	6	1	5	2	Not reached; <70% on one
14	Maintaining LTC medical records on residents with charting and documentation (including remote charting)	7	0	7	2	Reached; ≥70% on both	–	–	–	–	–
15	Conducting LTC medication management within mandated reviews (timeframe is jurisdiction dependent, feel free to note your mandated timeframe in textbox below)	7	1	7	2	Reached; ≥70% on both	–	–	–	–	–

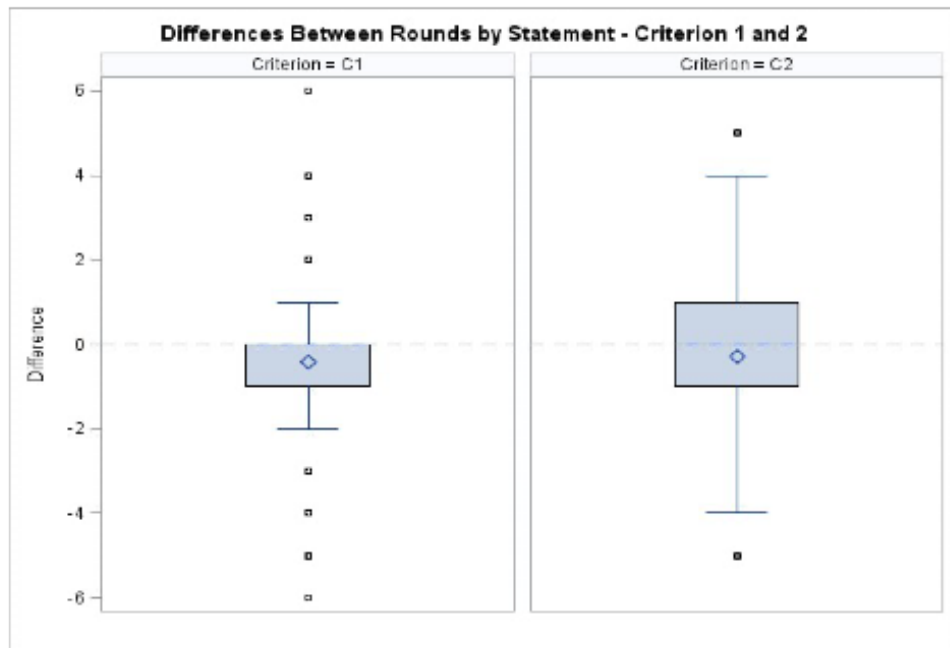
#	Statement	Round one					Round 2				
		Relevance		Feasibility		Result on consensus	Relevance		Feasibility		Result on consensus
		Median	IQR	Median	IQR		Median	IQR	Median	IQR	
16	Conducting LTC medication management beyond mandated reviews or ad-hoc (e.g., re-assessing psychotropic medications, reconciliation after hospitalization or other health care contact, etc.)	7	0.5	5	2.5	Reached; $\geq 70\%$ on both	–	–	–	–	–
17	Providing palliative care for chronic medical conditions and other serious illnesses for LTC residents	7	0	7	1	Reached; $\geq 70\%$ on both	–	–	–	–	–
18	Providing end-of-life care in the last weeks of life for LTC residents	7	0	7	1	Reached; $\geq 70\%$ on both	–	–	–	–	–
19	Certifying the death of residents within the LTC home, as needed	7	1	7	1	Reached; $\geq 70\%$ on both	–	–	–	–	–
20	Conducting in-person comprehensive admission assessments of LTC residents (including history, physical, and medication review)	7	1	7	1.5	Reached; $\geq 70\%$ on both	–	–	–	–	–
21	Conducting in-person annual reviews/history and physicals of LTC residents	5	5	5	3	Not reached; $< 70\%$ on both	–	–	–	–	–
21a	REVISED: Conducting in-person annual reviews of LTC residents	–	–	–	–	–	6	1	6	1	Reached; $\geq 70\%$ on both

#	Statement	Round one					Round 2				
		Relevance		Feasibility		Result on consensus	Relevance		Feasibility		Result on consensus
		Median	IQR	Median	IQR		Median	IQR	Median	IQR	
21b	REVISED: Conducting in-person history & physicals of LTC residents	–	–	–	–	–	3	2.5	5	3.5	Not reached; <70% on both
22	Conducting in-person assessments for a significant change in a LTC resident's physical or mental condition requiring a new evaluation, medication, or other therapeutic intervention	7	1.5	6	2	Reached; ≥70% on both	–	–	–	–	–
23	Participating in medical case rounds to assess LTC resident care and provide medical care as required	6	3	5	2	Not reached; <70% on both	*dropped from further evaluation				
24	Assessing LTC residents after emergency department visits, hospitalizations, and other external healthcare contact	6	2	5	2	Reached; ≥70% on both	–	–	–	–	–
25	Attending care conferences in-person for LTC practice	6	3	5	2.5	Not reached; <70% on both	6	1.5	5	2.5	Not reached; <70% on one
26	Attending care conferences remotely for LTC practice	6	3	6	3	Not reached; <70% on both	6	1.5	6	2.5	Reached; ≥70% on both
27	Attending care conferences when the team determines a LTC resident's medical needs as being unique, requiring special assessment, treatment, or change in treatment plan	7	1	6	2	Reached; ≥70% on both	–	–	–	–	–

#	Statement	Round one					Round 2				
		Relevance		Feasibility		Result on consensus	Relevance		Feasibility		Result on consensus
		Median	IQR	Median	IQR		Median	IQR	Median	IQR	
28	Having on-site presence in the LTC home(s) (physical presence)	7	0	7	1.5	Reached; $\geq 70\%$ on both	–	–	–	–	–
29	The number of LTC homes in which a primary care provider practices	4	3	5	2	Not reached; $< 70\%$ on both	4	1.5	5	2.5	Not reached; $< 70\%$ on both
30	Commuting (time and distance) to the LTC home(s) in which a primary care provider practices	5	2.5	4	3	Not reached; $< 70\%$ on both	*dropped from further evaluation				
31	Having additional practice designation and competence (e.g., Certificate in Added Competency such as Care of the Elderly, Palliative, Focused practice designation, Geriatrician specialty)	4	4	4	3	Not reached; $< 70\%$ on both	4	3	3	4	Not reached; $< 70\%$ on both
32	Being a Medical Director in LTC	5	3	5	2.5	Not reached; $< 70\%$ on both	5	2.5	5	4	Not reached; $< 70\%$ on both
33	Ongoing competency development focusing on clinical skills and expertise in LTC practice (e.g., Continuing medical education [CME], credentialing)	7	1	6	2	Reached; $\geq 70\%$ on both	–	–	–	–	–
34	Years of service towards LTC practice	6	2	5	2	Not reached; $< 70\%$ on both	5	3	5	3.5	Not reached; $< 70\%$ on both

#	Statement	Round one					Round 2				
		Relevance		Feasibility		Result on consensus	Relevance		Feasibility		Result on consensus
		Median	IQR	Median	IQR		Median	IQR	Median	IQR	
35	Cumulative LTC residents cared for over career lifetime	6	1.5	5	2	Not reached; <70% on one	6	1.5	4	4	Not reached; <70% on one
36	Advising, participating, and holding meetings with the LTC home as required (e.g., in-service education programs, working with administrative staff to discuss concerns relating to the care of residents)	6	2	5	2	Not reached; <70% on one	6	1.5	4	3	Not reached; <70% on one
37	Clinical leadership activities (e.g., monitoring and evaluating medical services, clinical policies and procedures, and/or participating on relevant committees, etc.)	5	1.5	5	1.5	Not reached; <70% on one	6	3	3	3.5	Not reached; <70% on both
38	Actively participating in quality improvement (QI), research, medical education, and/or scholarship in LTC	5	2.5	4	2.5	Not reached; <70% on both	–	–	–	–	–
38a	REVISED: Actively participating in quality improvement (QI) in LTC	–	–	–	–	–	6	1	5	2	Not reached; <70% on one
38b	REVISED: Actively participating in research in LTC	–	–	–	–	–	4	3.5	3	2.5	Not reached; <70% on both
38c	REVISED: Actively participating in medical education in LTC	–	–	–	–	–	6	2.5	4	3	Not reached; <70% on one

Supplemental Figure 1. Distribution of difference scores from the Wilcoxon matched-pairs signed-rank test.



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CHAPTER FIVE

Variation in Psychotropic & Non-Psychotropic Prescribing in Nursing Homes: A Multi-Level EMR-Based Retrospective Cohort Study

Summary

In this chapter, we examined a multi-level analysis of medication prescribing variation across NH units, homes, and organizations using EMR data in Ontario, Canada. This study builds on the recognition from the earlier chapters that care quality results from complex interactions across the LTC practice environment. I conducted a comprehensive study examining prescribing patterns for both psychotropic and non-psychotropic medications among 16,896 residents across 179 homes and 5 organizations. Using sophisticated four-level logistic regression models, this study reveals that prescribing variation extends far beyond antipsychotics, a well-known psychotropic with adverse effects, to include antidepressants, CVD medications, statins, and trazodone, which exhibited the highest variation of all medication classes studied. The analysis demonstrates that home-level variation consistently exceeded unit-level variation across all medications examined, while no significant organizational-level differences were detected due to limited power.

This study makes several novel contributions to the field. It represents the first large-scale analysis using EMR data from Ontario's largest NH EMR vendor, establishing a methodological framework for leveraging real-time clinical data in quality improvement efforts. The multi-level analytical approach provides unprecedented granularity in understanding where variation in prescribing decisions occurs, and that this variation is strongly influenced by unexplained home and unit factors. The finding

that trazodone shows the highest variation suggests an area for additional monitoring and research to examine potential reasons, such as substitution effects. These results provide actionable targets for unit- and home-level interventions, supporting the expansion of quality improvement efforts beyond traditional antipsychotic-focused initiatives to encompass comprehensive medication management approaches.

Citation

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Abstract

Background: Antipsychotic medications remain widely used in nursing homes (NHs) despite guidelines discouraging potentially inappropriate use. While home-level variation is known, less is understood at the unit and organization levels, or across other psychotropic and non-psychotropic drugs. We examined prescribing variation across NHs in Ontario, Canada. We examined prescribing variation for psychotropic and non-psychotropic drugs across NH units, homes, and organizations in Ontario, Canada.

Methods: We conducted a retrospective cohort study of NH residents using EMR data from April 1, 2022, to March 31, 2023. Outcomes included whether residents were prescribed any antipsychotic, antidepressant, statins, cardiovascular disease (CVD) medications, and trazodone for at least one day during the follow-up period. Multi-level logistic regression models adjusted for resident characteristics and included random intercepts for units, homes, and organizations.

Results: Among 16,896 NH residents across 179 homes and five organizations, 39% were prescribed antipsychotics, 65.5% antidepressants, 33% statins, 65% CVD medications, and 38% trazodone. Substantial variation was observed across all medications. For antipsychotics, the home-level median odds ratio (MOR) was 1.65 (95% CrI: 1.52-1.78) and unit-level MOR was 1.24 (95% CrI: 1.10-1.33). Trazodone exhibited the highest variation (home-level MOR: 2.06, 95% CrI 1.75-2.37; unit-level MOR: 1.87, 95% CrI 1.76-1.97). No significant variation was found at the organization-level. Resident characteristics, like aggression and dementia, were associated with prescribing, but did not explain unit and home-level differences.

Conclusions: Prescribing variation extends beyond antipsychotics to other common pharmacotherapies. Unit-level variation reveals additional unexplained variation not captured in previous home-level studies, providing new targets for research and quality improvement interventions. Future research should explore potential unit- and home-level contributors, such as staffing, practice culture, clinician decision-making, and policies.

Background

Antipsychotic medications are widely used in nursing homes (NHs). While clinical guidelines acknowledge circumstances where antipsychotics may be clinically indicated and appropriate, decades of international research highlight the risks and adverse health effects associated with inappropriate antipsychotic use, such as the increased risk of stroke, falls, cognitive decline, and mortality.^{1–8} Despite existing clinical guidelines, tools, and quality improvement initiatives,^{8–14} the rate of potentially inappropriate antipsychotic use in Canada reached 24.5% during 2022 – 2023.¹⁵ This has been rising since COVID-19,¹⁶ undoing previous gains. Comparable countries report lower rates: the United States at 21.3% for total antipsychotic use (14.4% potentially inappropriate use), Australia at 17.5% (8.9% potentially inappropriate use), and Belgium at 22.5%.^{17–20}

While resident characteristics partly explain antipsychotic prescribing variation, documented differences exist across NHs, influenced by factors such as home size, profit status, staffing, clinician behaviour, access to specialists, culture, and location.^{2,21–24} Less is known about whether this variation extends to the organization-level (a structured group of NHs under one management structure) or the unit-level (where care is organized and delivered within a home and where clinical decision-making occurs). Exploring variability at these levels could inform quality improvement efforts. It is also unknown whether such variation is specific to antipsychotics or extends to other psychotropic and non-psychotropic medications.

In most Canadian provinces and territories, medication use in NHs (known as long-term care homes in the Canadian context) is estimated using the Resident Assessment Instrument-Minimum Data Set (RAI-MDS) 2.0, a mandated clinical assessment conducted at resident admission and quarterly thereafter. The tool provides a snapshot of a resident's clinical profile, including data on medications taken in the prior seven days. While valuable for research and quality improvement, the periodic nature of the RAI-MDS 2.0 may exclude certain drugs, dosages, or intermittent drug use. Leveraging electronic medical records (EMRs) can provide more detailed, real-time data on residents' drug regimens to improve detection of pharmacotherapies and support timely interventions.²⁵

In this study, we used structured data from a novel repository of EMRs from NHs in Ontario, Canada, to assess prescribing variation across medication classes (antipsychotics, antidepressants, statins, cardiovascular disease [CVD] medications, and trazodone), adjusting for resident characteristics. Our multi-level design evaluated variation with residents nested within units, units within NHs, and NHs within organizations.

Methods

Our study was approved by the Hamilton Integrated Research Ethics Board (HiREB #17783), which waived the need for informed consent due to the use of anonymized secondary data. We report this study using the STROBE statement.²⁶

Study Design, Setting, and Participants

We conducted a retrospective cohort study of NH residents across five organizations representing 179 homes (29% of all NHs) in the most populous province

of Ontario, Canada. Canadian NHs do not focus on post-acute care and instead provide ongoing personal and nursing care to long-stay residents, which is publicly funded and provincially regulated. Each home is divided into designated units with resident beds and care teams for care delivery. In Ontario's NH system, prescribers are primarily family physicians who are typically assigned to specific units within homes and manage all comprehensive medical care, including prescriptions. Other physicians working within the home will support and provide medical coverage for resident care, ensuring 24/7 access to medical support. This unit-based assignment model means that prescribing patterns reflect clinical decision-making at the unit level, creating a relationship between unit-level prescribing variation and prescriber practice. We included all residents living in NH between April 1, 2022, and March 31, 2023, regardless of length of stay, excluding those identified as end-stage disease during the study period.

Data Source

Anonymized secondary EMR data were accessed through OnSPARK (Ontario Supporting Partnerships to Advance Care and Knowledge), a secure data platform hosted by McMaster University. Using EMR data provides more detailed clinical information than administrative data. In the study, the census dataset contained information about residents' NH stay, including admission date, discharge date, and the home and unit in which they resided. The Continuing Care Reporting System for Long-Term Care (CCRS-LTC) dataset contained the RAI-MDS 2.0, which provided key resident characteristics. Residents were included if they had at least one RAI-MDS 2.0 assessment during the study period, and characteristics were derived from the closest

RAI-MDS 2.0 assessment based on the study end date. The orders dataset included information on all prescribed medications such as the start date, end date, and dosage information. Medications were coded using the Anatomical Therapeutic Chemical (ATC) classification system.²⁷

Outcome Measures

We examined whether residents were prescribed any of the following (binary outcome): any antipsychotic, any antidepressant, any statin, any CVD medication, and any trazodone if residents were on the medication for at least one day over the follow-up period. The psychotropics selected (antipsychotics and antidepressants) were based on those most commonly prescribed in Ontario NHs, based on existing literature and our preliminary data analysis.^{28,29} Trazodone, though an antidepressant, was analyzed separately due to its potential use as a substitute in the Ontario context when antipsychotics are discontinued.^{30–32} Statins and CVD medications were included to assess whether prescribing variation extends beyond psychotropics. Medications were classified using ATC codes: antipsychotics (N05A); antidepressants including selective serotonin reuptake inhibitors (SSRIs; N06AB) and other antidepressants (N06AX); trazodone (N06AX05); statins (C10AA); and CVD medications, including antihypertensives (C02), diuretics (C03), beta-blockers (C07), calcium channel blockers (C08), and renin-angiotensin system agents (C09).

Covariates

We included a range of resident-level characteristics known to influence prescribing, such as demographics (age group, sex, height in centimetres, weight in kilograms), disease diagnoses, and signs and symptoms, including shortness of breath,

edema, and insomnia, as captured by standardized RAI-MDS 2.0 items. We included several validated clinical scales assessing activities of daily living (ADL), health instability, cognition, mood, aggression, and pain.^{33–38} We also noted whether residents resided in Alzheimer's/dementia special care unit and the average number of medications per resident. Unit- and home-level variables included home size (by beds: small <97, medium 97-160, large 160+), number of units (<5, 5-9, 10+), ownership type (non-profit, for-profit, publicly listed), and unit size (20-32 or 33+ beds).

Statistical Analyses

We summarized continuous variables using means (SD) and medians (IQR), and categorical variables through frequencies. Prescription rates for each medication class were plotted per 365 person-days by NH unit or home, calculated by dividing the total resident days on medication by total resident days in the NH unit or home, then multiplying by 365.

We used multi-level (four levels) multivariable logistic regression models to estimate the association between resident characteristics and each medication outcome prescribed. Exploratory analysis revealed bimodal exposure duration distributions (peaks at 0 and 365 days) across all medication classes, with very few residents having intermediate exposure durations. This distribution pattern supported the use of binary outcomes rather than continuous duration-based measures, as medication prescribing appeared to follow an "all-or-none" pattern rather than a gradual dose-response relationship. Effects were reported as odds ratios (ORs) and 95% confidence intervals (CIs). We adjusted for clustering with random intercepts at the unit, home, and organization levels. We fit two models for each outcome: (i) a null model

with no covariates, and (ii) a fully adjusted model with resident-level characteristics. We calculated variability measures (intraclass correlation [ICC], within-unit, home, and organization-level variance, and median odds ratio [MOR] with 95% credible intervals [CrI]). The MOR provides a more straightforward interpretation of variability for logistic regression methods, as the ICC underestimates the variation.³⁹ The MOR represents the average difference in risk between units, homes, or organizations on the OR scale. It is the median value of the distribution of all ORs created by comparing all pairwise combinations of units, homes, and organizations. Any MOR equal to one or a CrI whose lower bound includes one suggests no differences, but values >1 imply variation exists based on the clustering effect (i.e., units, homes, or organizations). Due to limited power at the organization level, organizational variability should be interpreted with caution. Analyses were conducted using SAS 9.4 and plots were created with R V4.3.2.

Results

We analyzed 16,896 residents across 179 NHs from five organizations in Ontario, Canada, from April 1, 2022, to March 31, 2023. Table 1 presents descriptive statistics of the total cohort (Supplement Table S1 provides additional characteristics). The majority of NH residents were between the ages of 85 – 94 years (38.5%), female (67.1%), with moderate to severe cognitive impairment (scores 3–6; 73.1%) and high ADL dependence (scores 3–6; 88.6%) (Table 1). Of the 16,896 residents in the study, 39.2% of residents were prescribed antipsychotics, 65.5% antidepressants, 32.7% statins, 64.9% CVD medications, and 37.9% trazodone (Supplemental Table S2). Most NHs in our study were medium-sized with 97-160 beds (40.8%) (Supplemental Table S3).

Figure 1 visualizes the wide variation in the prescription of trazodone across units (left panel) and NHs (right panel) based on a prescription rate per 365 person-days. Supplemental Figure S1 provides additional graphics of all other medication classes examined.

Multi-level analysis of covariates and medication outcomes.

Table 2 and Figure 2 summarize the results of the random-effects multi-level logistic regression models examining unit-, home-, and organization-level variability. Additional results regarding the models can be found in Supplemental Tables S4 and S5.

The null or unadjusted multi-level logistic regression models exhibited significant variability across unit and home levels (Table 2), with no significant variation at the organization-level, given that we had only five organizations. The MOR represents the average variation in prescribing rates between all possible combinations of units or homes. For antipsychotics (null models), we observed the highest variability at the home-level with a MOR of 1.44 (95% CrI: 1.33, 1.53), followed by the unit-level (MOR: 1.42, 95% CrI: 1.34, 1.49) (Table 2). In our final model (adjusted for resident characteristics), we similarly found substantial variation across unit and home levels. For antipsychotics, we observed the highest variability at the home-level with an increased MOR of 1.65 (95% CrI: 1.52, 1.78), followed by the unit-level (MOR: 1.24, 95% CrI: 1.10, 1.33) (Table 2, Figure 2). The finding of the highest variation at the home-level, followed by the unit-level, was consistent across other medication classes examined for both the null and final models.

With our separate focus on trazodone, we found that trazodone exhibited the highest variation among all medications examined. In the null model, the home-level MOR for trazodone was 2.19 (95% CrI: 1.96; 2.42), followed by the unit-level (MOR: 1.49; 95% CrI: 1.40; 1.57) (Table 2). In the final model, the home-level variability had an MOR of 2.06 (95% CrI: 1.75, 2.37) and a unit-level MOR of 1.87 (95% CrI: 1.76, 1.97) (Table 2, Figure 2).

To interpret these findings clinically, take the comparison of two homes. If one home had a rate of antipsychotic prescribing of 39.2% (as in our sample), the MOR of 1.65 indicates that the prescribing rate of another randomly selected home would be 51.5%, an absolute risk difference of 12.35%. However, if the prescribing rate in the second home were 28.2% instead, the absolute difference would be –11.00%. Both of these interpretations are consistent with an MOR of 1.65 at the home-level. For antipsychotics, the absolute risk difference at the unit-level was 5.23%. For trazodone, the absolute risk difference at the home-level was 17.80% and at the unit-level, 15.40%. It is important to note that the MOR is a relative measure of odds that does not translate into a fixed probability difference; the absolute differences shown here are illustrative examples.

In the adjusted models, resident-level characteristics were strongly associated with prescribing across medication classes as expected (Supplemental Table S5). For instance, for moderate to severe aggressive behaviour, the odds of antipsychotics were 2.54 higher (95% CI: 2.11, 3.06), the odds of antidepressants were 2.34 times higher (95% CI: 1.89, 2.90), the odds of trazodone were 2.91 higher (95% CI: 2.44-3.48) but the odds of statins were 0.76 times lower (95% CI: 0.62, 0.93). The addition of resident

characteristics did not substantially change the variability, and in some cases, the variation increased.

Discussion

In this multi-level analysis of NH medication prescribing across Ontario, Canada, we identified substantial variation across psychotropic and non-psychotropic medications, including antipsychotics, antidepressants, statins, CVD medications, and trazodone. Variation was the greatest at the home- followed by the unit-level, with little evidence of organization-level differences. Trazodone exhibited the highest variation of all medications examined, and while resident characteristics were associated with prescribing, they did not explain the variation at the home- or unit-levels.

Our results contribute to the broader literature documenting variation in NH prescribing at the home-level. Prior evidence from Canada has shown wide differences in antipsychotic prescriptions across NHs, from a mean of 20.9% to 44.3% in NHs with the highest prescribing rates.² For common psychoactive and non-psychotic drug classes, Bronskill and colleagues reported a threefold variation in polypharmacy rates across NHs and found that resident characteristics did not fully explain high polypharmacy rates.⁴⁰ They found that other factors, such as overall NH prescribing rates and the number of clinician prescribers, influenced polypharmacy.⁴⁰ This is consistent with other international evidence, which also finds that home-level variation in medication use and safety is shaped by structural and contextual factors.^{3,4,23,41–45} The sum of prior evidence supports the notion that home factors beyond resident characteristics, such as organization and team culture, policies, staffing, collaboration,

access to resources, home characteristics, medical care leadership, may be potential reasons for the unexplained home-level variation in our sample.

The present study extends this literature in two ways. First, by leveraging EMR data, we were able to understand variation across multiple therapeutic classes with greater precision than administrative datasets typically allow. Second, our use of four-level models allowed separation of unit-, home-, and organization-level effects. While earlier research has highlighted unexplained variation at the home-level, our study uniquely shows that prescribing practices also differ meaningfully between NH units. This suggests that some variation is more closely tied to prescriber and/or care team factors at the unit-level, including consideration of medical staff's clinical practice and decision-making practices, team dynamics, and capacity for non-pharmacological treatments, which may play a significant role. The absence of significant organization-level effects in our study should not be interpreted as indicating no influence due to organizational structure. Rather, the limited number of organizations likely constrained our ability to detect differences. One study in the U.S. has found that chain ownership decreased antipsychotic use,⁴³ and future studies should explore this further to understand the organizational variation with larger samples.

Our analysis provides insight that prescribing decisions are most influenced by the NH hierarchy, with home-level variation exceeding unit-level variation. This suggests influences at the level of institutional culture, leadership, or local (unit) care processes. For example, prescribing may be shaped by how homes organize interdisciplinary teams, the presence of medical directors, or expectations communicated by administrators. At the unit level, staffing stability, availability of

geriatric psychiatry and pharmacy support, and prescriber assignment patterns may play a role. Our study could not directly measure these potential mechanisms of action; further research on these factors may be warranted. For instance, prescribing assignment patterns, such as one physician covering multiple units with differing approaches, may generate within-home variation. In addition, while we adjusted for measured resident characteristics as comprehensively as possible, unmeasured differences in case-mix or resident complexity may also contribute. Nevertheless, the persistence of variation after adjusting for resident characteristics indicates local and home practice meaningfully influence prescribing.

The decision to analyze trazodone separately revealed that this medication had the greatest variability, exceeding that which we observed for antipsychotics. Though categorized as an antidepressant, trazodone is frequently used for insomnia and behavioural symptoms.^{46,47} This heterogeneity of clinical use scenarios may partly explain the wide variation we observed, despite current clinical guidelines cautioning against the routine use of trazodone for sleep or behavioural symptoms due to limited evidence of benefit and known safety concerns.^{48–53} Previous studies from Ontario and the U.S. have raised concerns about the potential substitution of trazodone for antipsychotics or benzodiazepines.^{30–32,47,54,55} While our analysis cannot confirm substitution effects, we highlight trazodone as an area warranting further investigation, particularly regarding its indications, appropriateness, and potential role as a substitute when other psychotropic medications are reduced.

The findings carry important implications. First, they suggest that interventions should be targeted at home and unit levels, where the majority of variation resides. Second, the presence of variation across antidepressants, CVD medications, and statins highlights that prescribing variation is not limited to antipsychotics. Current quality monitoring frameworks in Ontario and elsewhere largely focus on antipsychotic medications.^{7,56} Expanding public reporting to other therapeutic classes could provide a more comprehensive view of prescribing practices in dashboards and accreditation standards. However, such expansion must be approached cautiously. While public reporting of antipsychotics and reduction efforts have demonstrated a decrease in antipsychotic rates,^{30,47,54} there is potential for unintended consequences, such as substitution effects.^{30,32,47,54,55} Policies should therefore ensure reporting is accompanied by safeguards to prevent metric-driven shifts in prescribing rather than genuine improvements in care. Examples of potential investments include building team capacities, integrated pharmacist support, staff training, resources for non-pharmacological care, adequate staffing, and clinician support.^{7,12,56} Third, the integration of EMR-based analytics into learning health systems offers a promising path forward. EMR data can generate real-time, actionable insights and embedding such analytics into feedback dashboards for prescribers and care teams could support more responsive and targeted quality improvement at the point of care.

Limitations and Strengths

While this study leveraged a novel EMR database and multi-level design, several limitations remain. First, we were unable to attribute prescriptions to individual physicians. Because non-physician staff frequently enter orders, prescriber identity,

timing, and indication were unavailable, limiting our ability to assess continuity of care or clinician-level variability. Similarly, we could not differentiate between continuous, standard, or as-needed medication orders. Nonetheless, the unit-level analysis likely reflects clinician prescribing patterns, as family physicians in Ontario are typically assigned to specific units.

Second, we lacked detailed information on structural or contextual characteristics of units, homes, and organizations that could explain observed variation. Although we detected significant variation at the unit and home levels, the study was underpowered to identify organization-level effects, and organizational homogeneity (five organizations, predominantly for-profit chains) may have limited our ability to detect such differences.

Third, our sample was restricted to homes in Ontario, the majority of which were for-profit. Prescribing cultures, resource availability, and quality improvement priorities may differ in non-profit or publicly operated facilities, and Ontario's regulatory and policy environment, including drug formularies and public reporting initiatives, may influence prescribing in ways not generalizable to other Canadian provinces or jurisdictions.

Finally, our analysis was limited to selected drug classes and did not assess benzodiazepines or Z-drugs, which warrant further study given their known risks and overlapping indications. We also could not evaluate the clinical appropriateness of prescriptions, as unstructured clinical notes were not available.

Our study also represents innovative elements for data-driven NH research. We conducted the first large-scale analysis using EMR data from Ontario's largest NH EMR vendor, establishing a methodological framework for leveraging EMR analytics in NH

quality improvement. Our multi-level analytical approach examining variation across residents, units, homes, and organizations provides unmatched granularity beyond previous research, with unit-level analysis capturing practice patterns where clinical decisions occur. Lastly, examining multiple medication classes beyond the traditionally studied antipsychotics reveals systemic prescribing variation patterns with important implications for comprehensive medication management in NHs.

Conclusions

Prescribing variation in Ontario NHs extends well beyond antipsychotics to other common pharmacotherapies, with unexplained variation at both the unit- and home-levels. Trazodone demonstrated the highest variability, raising questions for future research. These findings emphasize the importance of moving beyond single-drug indicators of quality and targeting quality improvement with multi-pronged approaches that invest in staffing and non-pharmacological supports, which can support monitoring and translate into meaningful improvements in resident-centered care.

Tables and Figures

Table 1. Characteristics of NH residents, by anti-psychotics prescription, April 1, 2022 – March 31, 2023

Characteristic	No antipsychotics prescribed (n = 10,282)	Antipsychotics prescribed (n = 6,614)	Total (n = 16,896)
Age group, no. (%)			
<65 years	711 (6.91%)	622 (9.40%)	1333 (7.89%)
65-74 years	1257 (12.23%)	1205 (18.22%)	2462 (14.57%)
75-84 years	2698 (26.24%)	1965 (29.71%)	4663 (27.60%)
85-94 years	4242 (41.26%)	2261 (34.19%)	6503 (38.49%)
95+ years	1374 (13.36%)	561 (8.48%)	1935 (11.45%)
Female sex, no. (%)	7065 (68.71%)	4272 (64.59%)	11337 (67.10%)
No. of medications, mean (SD)	10.61 (4.77)	11.59 (4.60)	10.99 (4.73)
SCALES*			
Aggression (ABS), no. (%)			
Intact (0)	7523 (73.17%)	3485 (52.69%)	11008 (65.15%)
Mild aggressive behaviour (1-4)	2454 (23.87%)	2573 (38.90%)	5027 (29.75%)
Moderate to severe aggressive behaviour (5-12)	305 (2.97%)	556 (8.41%)	861 (5.10%)
Activities of Daily Living (ADL), no. (%)			
No dependence (0)	233 (2.27%)	134 (2.03%)	367 (3.12%)
Some dependence (1-2)	963 (9.37%)	589 (8.91%)	1552 (9.19%)
High dependence (3-6)	9086 (88.37%)	5891 (89.07%)	14977 (88.64%)
Health Instability (CHESS), no. (%)			
Lowest 0	4783 (46.52%)	3005 (45.43%)	7788 (46.09%)
1	3872 (37.66%)	2428 (36.71%)	6300 (37.29%)
2	1351 (13.14%)	935 (14.14%)	2286 (13.53%)
3	240 (2.33%)	199 (3.01%)	439 (2.60%)
Highest 4	36 (0.35%)	47 (0.71%)	83 (0.49%)
Cognition (CPS) no. (%)			
Intact (0)	902 (8.77%)	222 (3.36%)	1124 (6.65%)
Mild cognitive impairment (1-2)	2420 (23.54%)	995 (15.04%)	3415 (20.21%)
Moderate to severe cognitive impairment (3-6)	6960 (67.69%)	5397 (81.60%)	12357 (73.14%)
Depression (DRS), no. (%)			
No signs of depressive symptoms (<3)	9004 (87.57%)	4965 (75.07%)	13969 (82.68%)
Signs of depressive symptoms (3+)	1278 (12.43%)	1649 (24.93%)	2927 (17.32%)
Pain Scale, no. (%)			
No pain (0)	8758 (85.18%)	5529 (83.60%)	14287 (84.56%)

Less than daily pain (1)	1317 (12.81%)	936 (14.15%)	2253 (13.33%)
2	162 (1.58%)	119 (1.80%)	281 (1.66%)
3	45 (0.44%)	30 (0.45%)	75 (0.44%)
Disease diagnoses & chronic conditions, no. (%)			
Dementia and/or Alzheimer's disease	6049 (58.83%)	4603 (69.59%)	10652 (63.04%)
Stroke (CVA)	2431 (23.64%)	1072 (16.21%)	3503 (20.73%)
CHF	1040 (10.11%)	620 (9.37%)	1660 (9.82%)
Diabetes	2987 (29.05%)	1854 (28.03%)	4841 (28.65%)
Hypertension	6767 (65.81%)	4017 (60.73%)	10784 (63.83%)
Arteriosclerotic heart disease	1592 (15.48%)	954 (14.42%)	2546 (15.07%)
Asthma/Emphysema/COPD	1744 (16.96%)	1228 (18.57%)	2972 (17.59%)
Huntington's Disease	12 (0.12%)	31 (0.47%)	43 (0.25%)
Hallucinations	216 (2.10%)	906 (13.70%)	1122 (6.64%)
Schizophrenia	122 (1.19%)	860 (13.00%)	982 (5.81%)
Delusions	552 (5.37%)	1785 (26.99%)	2337 (13.83%)
Bi-polar Disease	111 (1.08%)	461 (6.97%)	572 (3.39%)
Anxiety disorder	1451 (14.11%)	1417 (21.42%)	2868 (16.97%)
Depression	3201 (31.13%)	2628 (39.73%)	5829 (34.50%)
Alzheimer's/dementia special care unit, no. (%)	1402 (13.64%)	1499 (22.66%)	2901 (17.17%)
SD = standard deviation, CHF = congestive heart failure, COPD = chronic obstructive pulmonary disease, CVA = cerebrovascular accident			
*ADL Activities of Daily Living Hierarchy Scale, includes personal hygiene, locomotion, eating, toileting, scale from 0-6			
ABS Aggressive Behaviour Scale, which measures the degree of aggressive behaviour, scale from 0-12			
CHESS Changes in Health, End-Stage Disease and Signs and Symptoms, which detects health instability and a person at risk of decline, scale from 0-5			
CPS Cognitive Performance Scale, which measures the degree of cognitive impairment, scale from 0-6			
DRS Depression Rating Scale, which measures the degree of depression, scale from 0-14			
Pain Scale, which measures the presence and intensity of pain, scale from 0-3			

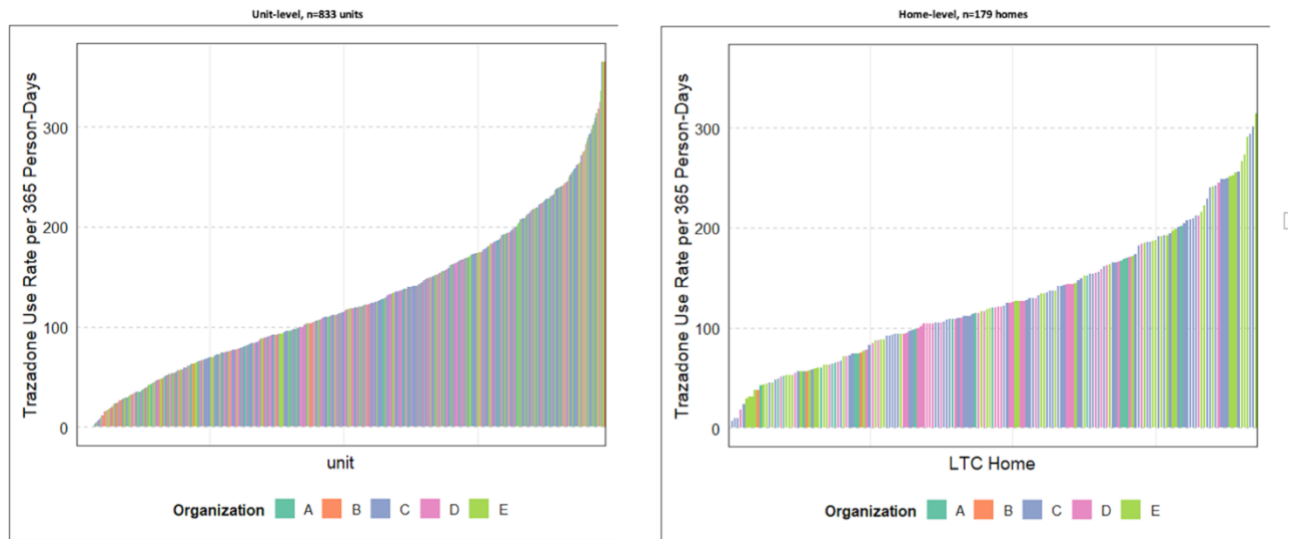


Figure 1. Prescription rate of trazodone per 365 person-days across NH units and homes, April 1, 2022 – March 31, 2023

Table 2. Variability statistics from multi-level logistic regression models for any prescription of psychotropics and non-psychotropic medications across null and final models, April 1, 2022 – March 31, 2023

VARIABILITY STATISTICS	OUTCOMES – MEDICATION PRESCRIPTIONS				
	Antipsychotics	Antidepressants	Statins	CVD medications	Trazadone
RANDOM EFFECTS (NULL MODEL)					
AUC/C Statistic (95 % CI)	0.67 (0.66, 0.68)	0.67 (0.66, 0.68)	0.70 (0.69, 0.71)	0.62 (0.61, 0.63)	0.74 (0.73, 0.74)
Organization level MOR (95% CrI)	1.08 (1.00, 1.16)	1.07 (1.00, 1.16)	1.42 (1.00, 1.74)	1.05 (1.00, 1.11)	1.04 (1.00, 1.23)
Home level MOR (95% CrI)	1.44 (1.33, 1.53)	1.72 (1.58, 1.85)	1.57 (1.45, 1.67)	1.33 (1.25, 1.40)	2.19 (1.96, 2.42)
Unit level MOR (95% CrI)	1.42 (1.34, 1.49)	1.33 (1.24, 1.40)	1.34 (1.25, 1.41)	1.20 (1.09, 1.27)	1.49 (1.40, 1.57)
RANDOM EFFECTS (FINAL ADJUSTED MODEL)					
AUC/C Statistic (95 % CI)	0.82 (0.81, 0.83)	0.77 (0.76, 0.77)	0.79 (0.78, 0.80)	0.79 (0.79, 0.80)	0.78 (0.77, 0.79)
Organization level MOR (95% CrI)	1.22 (1.00, 1.37)	1.14 (1.00, 1.26)	1.52 (1.00, 1.97)	1.10 (1.00, 1.20)	–
Home level MOR (95% CrI)	1.65 (1.52, 1.78)	1.78 (1.63, 1.93)	1.74 (1.58, 1.89)	1.40 (1.31, 1.48)	2.06 (1.75, 2.37)
Unit level MOR (95% CrI)	1.24 (1.10, 1.33)	1.30 (1.20, 1.38)	1.28 (1.18, 1.37)	–	1.87 (1.76, 1.97)
CVD = cardiovascular disease, AUC = area under the curve, CI = confidence interval, SE = standard error, ICC = intraclass correlation coefficient, MOR = median odds ratio, CrI = credible interval					

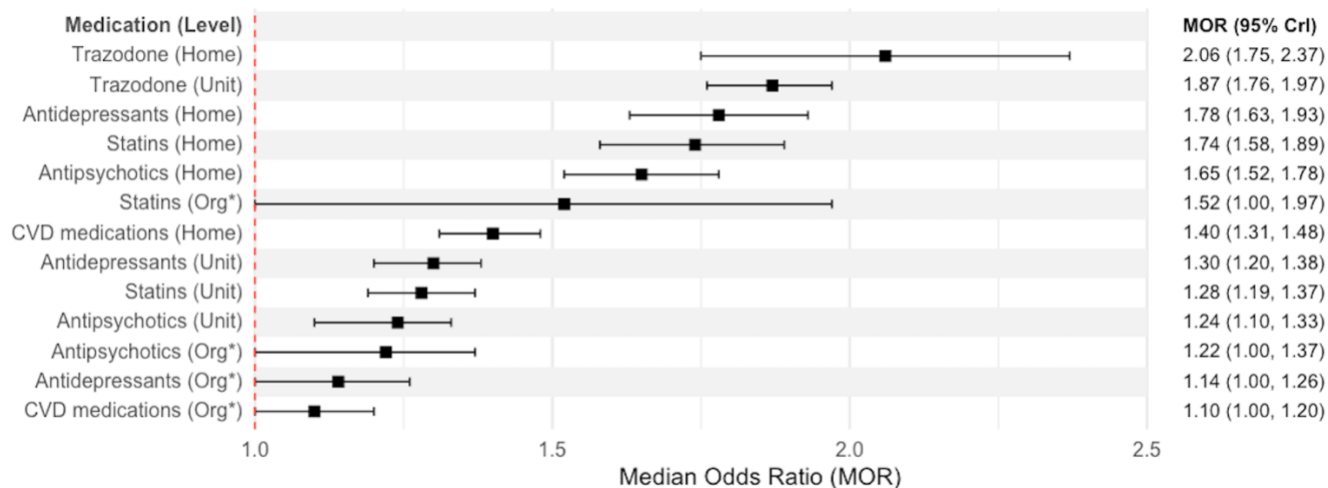


Figure 2. Forest plot of variation in medication use – median odds ratios (MORs) across home, unit, and organization levels, April 1, 2022 to March 31, 2023

Aps = antipsychotics, Ads = antidepressants, Org = organization, CVD = cardiovascular disease, CrI = credible interval

*Organizational-level variability is not significant, given that the lower bound includes 1.0

Appendices

Appendix 1. STROBE Statement—Checklist of items that should be included in reports of cohort studies

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	Title, abstract
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Introduction
Objectives	3	State specific objectives, including any prespecified hypotheses	Intro, para. 4
Methods			
Study design	4	Present key elements of study design early in the paper	Methods, para. 2
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Methods, para. 2
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed	Methods, para. 2, 3
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Methods, para. 4, 5
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Methods, para. 3, 4, 5
Bias	9	Describe any efforts to address potential sources of bias	Methods
Study size	10	Explain how the study size was arrived at	Methods, para. 2
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Methods, para. 5
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, explain how loss to follow-up was addressed (e) Describe any sensitivity analyses	Methods, para. 6, 7
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage	Results, para. 1

		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	Results, para. 1
Outcome data	15*	Report numbers of outcome events or summary measures over time	Results, para. 1
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Table 2, Figure 2, Supplemental Table 4, 5
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Supplemental Table 4, 5
Discussion			
Key results	18	Summarise key results with reference to study objectives	Discussion, para. 1
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Limitations
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Discussion, para. 2, 3, 4, 5, 6
Generalisability	21	Discuss the generalisability (external validity) of the study results	Limitations
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Title page

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

Supplemental Table S1. Additional characteristics of NH residents, by anti-psychotic medication (APM) prescription, April 1, 2022 – March 31, 2023

Characteristic	No antipsychotics prescribed (n = 10,282)	Antipsychotics prescribed (n = 6,614)	Total (n = 16,896)
Height (cm), Mean (SD)	160.61(10.97)	161.66 (12.03)	161.02 (11.41)
Weight (kg), Mean (SD)	68.94 (22.63)	71.28 (20.68)	69.86 (21.92)
Signs & symptoms, no. (%)			
Shortness of breath, no. (%)	342 (3.33%)	207 (3.13%)	549 (3.25%)
Edema, no. (%)	978 (9.51%)	571 (8.63%)	1549 (9.17%)
Insomnia or change in sleep pattern, no. (%)	9646 (93.81%)	5810 (87.84%)	15456 (91.48%)
Not exhibited in last 30 days	612 (5.95 %)	767 (11.60%)	1379 (8.16%)
Exhibited up to 5 days/week	24 (0.23%)	37 (0.56%)	61 (0.36%)
Exhibited daily or almost daily			
Behaviour Symptoms, no. (%)	9030 (87.82%)	5261 (79.54%)	14291 (84.58%)
No change	715 (6.95%)	759 (11.48%)	1474 (8.72%)
Deteriorated	537 (5.22%)	594 (8.98%)	1131 (6.69%)
Improved			
Bed bound, no. (%)	356 (3.46%)	187 (2.83%)	543 (3.21%)
SD = standard deviation			

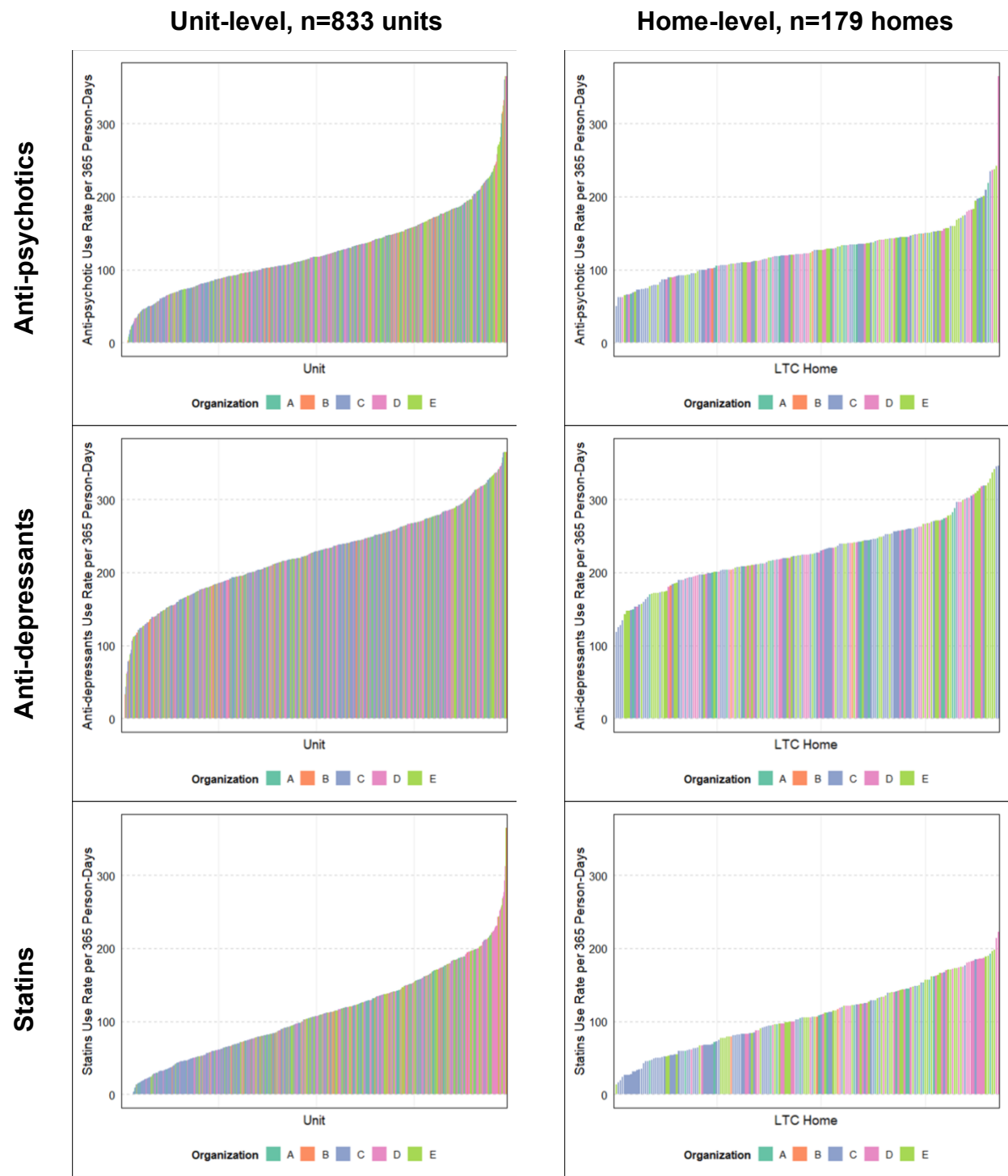
Supplemental Table S2. Additional characteristics of NH residents, by anti-psychotic medication (APM) prescription, April 1, 2022 – March 31, 2023

Outcome	Proportion of total sample; n = 16,896 n (%)
Proportion of NH residents prescribed an antipsychotic	6614 (39.2%)
Proportion of NH residents prescribed an antidepressant	11061 (65.5%)
Proportion of NH residents prescribed a statin	5531 (32.7%)
Proportion of NH residents prescribed CVD medications	10971 (64.9%)
Proportion of NH residents prescribed trazodone	6406 (37.9%)

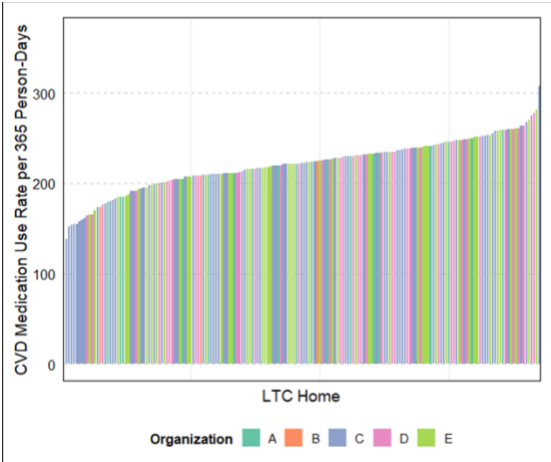
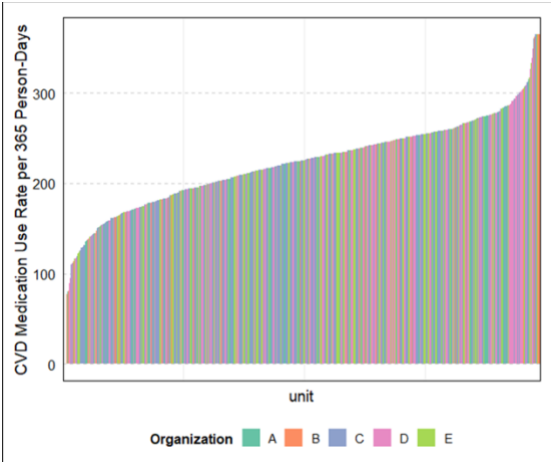
Supplemental Table S3. Home characteristics of included NH residents, April 1, 2022 – March 31, 2023

Characteristic	n=179 homes
Home size (beds), no. (%)	
small: <97 beds	48 (26.8%)
medium: 97-160 beds	73 (40.8%)
large: 160+ beds	58 (32.4%)
Home size (units), no. (%)	
<5 units	96 (53.6%)
5 – 9 units	75 (41.9%)
10+ units	8 (4.5%)
Ownership status, no (%)	
Non-profit charitable	3 (1.7%)
Primarily owned for-profit	17 (9.5%)
Publicly listed for-profit	159 (88.8%)
Unit Size (beds), no. (%)	833 units
20 – 32 beds per unit	635 (76.2%)
33 or more beds per unit	198 (23.8%)

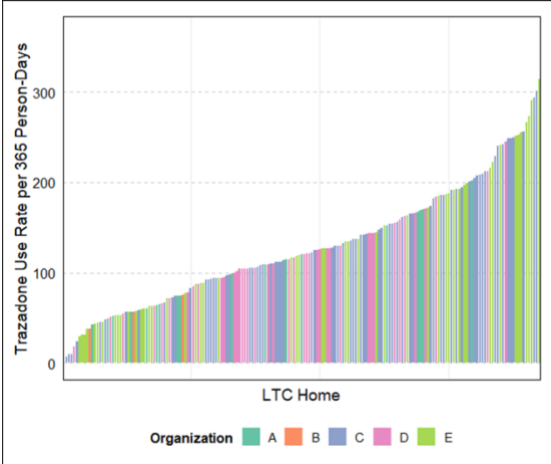
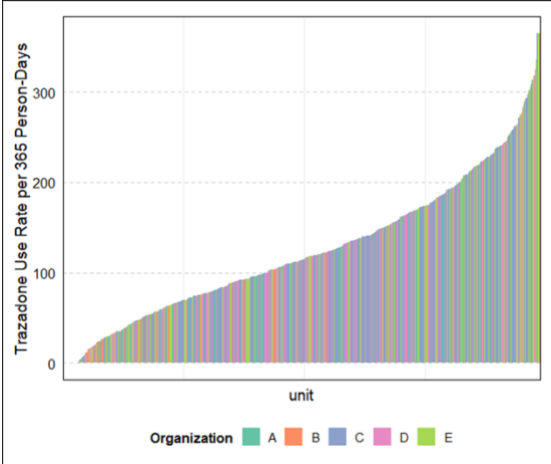
Supplemental Figure S1. Panel graphic of prescription rate across psychotropic and non-psychotropic medications per 365 person-days across NH units and homes, April 1, 2022 – March 31, 2023



CVD Medications



Trazodone



Supplemental Table S4. Multi-level logistic regression null/unadjusted models for the odds ratio of any prescription of psychotropic and non-psychotropic medications, from April 1, 2022 to March 31, 2023, n = 16,896

OUTCOMES – MEDICATION PRESCRIPTIONS					
VARIABILITY STATISTICS	Antipsychotics	Antidepressants	Statins	CVD medications	Trazadone
RANDOM EFFECTS (NULL MODEL)					
AUC/C Statistic (95 % CI)	0.67 (0.66, 0.68)	0.67 (0.66, 0.68)	0.70 (0.69, 0.71)	0.62 (0.61, 0.63)	0.74 (0.73, 0.74)
Organization level					
Covariance (95 % CI)	0.007 (-0.011, 0.025)	0.005 (-0.014, 0.025)	0.123 (-0.06, 0.32)	0.003 (-0.006, 0.012)	0.001 (-0.043, 0.046)
SE	0.009	0.010	0.097	0.004	0.023
ICC	0.002	0.002	0.038	0.001	0.0004
MOR (95% CrI)	1.08 (1.00, 1.16)	1.07 (1.00, 1.16)	1.42 (1.00, 1.74)	1.05 (1.00, 1.11)	1.04 (1.00, 1.23)
Home level					
Covariance (95% CI)	0.14 (0.089, 0.19)	0.31 (0.22, 0.40)	0.21 (0.15, 0.28)	0.087 (0.054, 0.12)	0.65 (0.48, 0.82)
SE	0.026	0.046	0.033	0.017	0.087
ICC	0.041	0.086	0.061	0.026	0.165
MOR (95% CrI)	1.44 (1.33, 1.53)	1.72 (1.58, 1.85)	1.57 (1.45, 1.67)	1.33 (1.25, 1.40)	2.19 (1.96, 2.42)
Unit level					
Covariance (95% CI)	0.13 (0.088, 0.17)	0.085 (0.050, 0.12)	0.090 (0.054, 0.13)	0.036 (0.009, 0.063)	0.17 (0.12, 0.21)
SE	0.01973	0.01782	0.01817	0.01389	0.0233
ICC	0.037	0.025	0.027	0.011	0.048
MOR (95% CrI)	1.42 (1.34, 1.49)	1.33 (1.24, 1.40)	1.34 (1.25, 1.41)	1.20 (1.09, 1.27)	1.49 (1.40, 1.57)
CVD = cardiovascular disease, AUC = area under the curve, CI = confidence interval, SE = standard error, ICC = intraclass correlation coefficient, MOR = median odds ratio, CrI = credible interval					

Supplemental Table S5. Multi-level adjusted logistic regression models for the odds ratio of any prescription of psychotropic and non-psychotropic medications, from April 1, 2022 to March 31, 2023, n = 16,896

OR (95% CI)	OUTCOMES – MEDICATION PRESCRIPTIONS				
	Antipsychotics	Antidepressants	Statins	CVD medications	Trazadone
RESIDENT CHARACTERISTICS					
Age group, years (ref: < 65 years)					
66-74	0.92 (0.78, 1.09)	0.95 (0.81, 1.11)	1.17 (1.00, 1.37)	1.37 (1.17, 1.61)	1.02 (0.87, 1.20)
75-84	0.66 (0.56, 0.77)	0.97 (0.83, 1.12)	0.98 (0.84, 1.14)	1.59 (1.36, 1.85)	0.97 (0.83, 1.12)
85-94	0.53 (0.46, 0.63)	0.95 (0.81, 1.10)	0.66 (0.57, 0.77)	1.76 (1.51, 2.05)	0.99 (0.85, 1.15)
95+	0.47 (0.39, 0.57)	0.77 (0.65, 0.92)	0.33 (0.27, 0.40)	1.87 (1.55, 2.24)	0.91 (0.76, 1.08)
Female sex	0.71 (0.65, 0.79)	0.97 (0.88, 1.06)	0.66 (0.60, 0.72)	1.06 (0.97, 1.17)	0.82 (0.75, 0.90)
Weight	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)
Height	1.00 (0.99, 1.00)	1.01 (1.00, 1.01)	1.00 (1.00, 1.00)	1.00 (1.00, 1.01)	1.00 (1.00, 1.00)
Scales					
ABS (ref: intact 0)					
Mild aggressive behaviour (1-4)	1.66 (1.52, 1.83)	1.73 (1.57, 1.90)	0.88 (0.80, 0.97)	0.93 (0.85, 1.02)	1.86 (1.70, 2.03)
Moderate to severe aggressive behaviour (5-12)	2.54 (2.11, 3.06)	2.34 (1.89, 2.90)	0.76 (0.62, 0.93)	0.95 (0.79, 1.14)	2.91 (2.44, 3.48)
ADL (ref: 0)					
Some dependence (1-2)	0.93 (0.70, 1.25)	0.94 (0.72, 1.22)	1.42 (1.06, 1.88)	0.90 (0.68, 1.20)	0.71 (0.54, 0.94)
High dependence (3-6)	0.91 (0.70, 1.20)	1.21 (0.95, 1.55)	1.08 (0.83, 1.41)	0.72 (0.55, 0.94)	0.85 (0.66, 1.09)
CHESS Scale (ref: 0)					
1	1.01 (0.92, 1.10)	1.05 (0.96, 1.14)	0.96 (0.88, 1.04)	0.99 (0.91, 1.08)	1.04 (0.96, 1.13)
2	1.09 (0.96, 1.24)	1.14 (1.01, 1.30)	1.02 (0.90, 1.17)	1.01 (0.89, 1.15)	1.13 (1.00, 1.27)
3	1.35 (1.06, 1.73)	1.11 (0.87, 1.42)	1.21 (0.94, 1.55)	1.28 (0.98, 1.67)	0.98 (0.78, 1.24)
4	2.01 (1.18, 3.44)	1.13 (0.65, 1.95)	1.27 (0.73, 2.22)	1.07 (0.61, 1.89)	0.96 (0.58, 1.58)
CPS (ref: 0)					

Mild cognitive impairment (1-2)	1.49 (1.23, 1.82)	1.15 (0.98, 1.34)	1.00 (0.85, 1.18)	0.95 (0.79, 1.14)	1.02 (0.86, 1.21)
Moderate to severe cognitive impairment (3-6)	2.27 (1.87, 2.76)	1.33 (1.14, 1.56)	0.79 (0.67, 0.93)	0.69 (0.58, 0.83)	1.49 (1.26, 1.77)
DRS (ref: 0)					
3+	1.48 (1.33, 1.66)	1.30 (1.16, 1.46)	1.14 (1.02, 1.28)	1.15 (1.03, 1.29)	1.15 (1.04, 1.28)
Pain Scale (ref: 0)					
1	1.06 (0.95, 1.19)	1.22 (1.09, 1.37)	1.08 (0.96, 1.21)	1.34 (1.19, 1.51)	1.24 (1.11, 1.38)
2	1.17 (0.86, 1.58)	1.00 (0.75, 1.34)	1.12 (0.84, 1.50)	1.89 (1.35, 2.64)	0.94 (0.71, 1.27)
3	0.96 (0.54, 1.71)	0.85 (0.49, 1.49)	0.68 (0.39, 1.20)	1.42 (0.79, 2.56)	1.15 (0.68, 1.94)
Disease Diagnoses & Chronic Conditions					
Dementia and/or Alzheimer's disease	1.52 (1.38, 1.68)	1.31 (1.20, 1.43)	0.84 (0.77, 0.92)	0.79 (0.72, 0.86)	1.38 (1.26, 1.50)
Stroke (CVA)	0.67 (0.61, 0.74)	1.02 (0.93, 1.12)	2.45 (2.24, 2.68)	1.34 (1.22, 1.48)	0.97 (0.89, 1.07)
CHF	1.24 (1.09, 1.41)	1.04 (0.92, 1.17)	1.09 (0.96, 1.23)	4.44 (3.71, 5.32)	0.91 (0.81, 1.03)
Diabetes	0.96 (0.88, 1.05)	1.05 (0.97, 1.14)	2.41 (2.22, 2.61)	1.61 (1.47, 1.75)	1.01 (0.93, 1.09)
Hypertension	0.98 (0.90, 1.06)	1.05 (0.97, 1.13)	1.80 (1.65, 1.95)	5.00 (4.64, 5.40)	1.10 (1.02, 1.19)
Arteriosclerotic heart disease	0.92 (0.83, 1.03)	1.00 (0.90, 1.11)	1.89 (1.71, 2.10)	1.46 (1.30, 1.63)	1.04 (0.94, 1.15)
Asthma/Emphysema	1.05 (0.95, 1.17)	1.14 (1.03, 1.26)	1.13 (1.03, 1.25)	0.98 (0.88, 1.08)	1.12 (1.02, 1.23)
Huntington's Disease	3.80 (1.80, 8.05)	1.66 (0.77, 3.60)	0.40 (0.14, 1.09)	0.32 (0.14, 0.74)	0.70 (0.35, 1.39)
Hallucinations	4.28 (3.57, 5.14)	1.35 (1.13, 1.60)	0.84 (0.71, 1.00)	1.02 (0.87, 1.20)	1.17 (1.01, 1.37)
Schizophrenia	15.94 (12.87, 19.75)	0.77 (0.66, 0.91)	1.04 (0.88, 1.22)	0.90 (0.77, 1.06)	0.82 (0.70, 0.96)
Delusions	4.73 (4.15, 5.40)	1.37 (1.20, 1.57)	0.95 (0.83, 1.08)	1.04 (0.92, 1.18)	1.19 (1.06, 1.34)
Bi-polar Disease	6.52 (5.13, 8.31)	0.78 (0.64, 0.95)	1.01 (0.82, 1.23)	0.96 (0.79, 1.18)	0.89 (0.73, 1.09)
Anxiety disorder	1.43 (1.29, 1.58)	1.72 (1.54, 1.92)	0.99 (0.89, 1.10)	1.05 (0.95, 1.16)	1.27 (1.15, 1.40)
Depression	1.32 (1.21, 1.43)	3.27 (3.00, 3.56)	1.03 (0.95, 1.12)	0.94 (0.87, 1.02)	1.15 (1.06, 1.24)
Signs & Symptoms					
Shortness of breath	0.83 (0.66, 1.04)	1.19 (0.95, 1.49)	0.85 (0.68, 1.07)	1.69 (1.31, 2.17)	1.37 (1.11, 1.69)
Edema	0.87 (0.75, 1.01)	0.89 (0.77, 1.02)	1.04 (0.90, 1.20)	2.40 (2.03, 2.83)	0.90 (0.78, 1.03)

Insomnia (ref: none in last 30 days)					
Exhibited up to 5 days/week	1.40 (1.22, 1.61)	1.47 (1.27, 1.72)	1.14 (0.98, 1.31)	1.00 (0.87, 1.15)	1.61 (1.41, 1.84)
Exhibited daily or almost daily	1.35 (0.72, 2.53)	0.92 (0.49, 1.73)	0.84 (0.43, 1.61)	1.14 (0.62, 2.11)	1.16 (0.65, 2.07)
Behaviour Symptoms (ref: no change)					
Improved	1.65 (1.42, 1.92)	1.21 (1.03, 1.42)	0.82 (0.70, 0.97)	0.94 (0.81, 1.09)	1.23 (1.06, 1.42)
Deteriorated	0.95 (0.82, 1.11)	0.99 (0.84, 1.15)	0.97 (0.83, 1.14)	1.11 (0.96, 1.29)	0.87 (0.76, 1.00)
Bed bound	0.94 (0.76, 1.16)	0.80 (0.66, 0.98)	0.82 (0.66, 1.01)	0.67 (0.54, 0.82)	0.81 (0.66, 1.00)
Alzheimer's/dementia special care unit	1.30 (1.15, 1.47)	1.27 (1.11, 1.44)	0.90 (0.79, 1.03)	0.84 (0.75, 0.93)	1.16 (1.01, 1.34)
VARIABILITY STATISTICS					
AUC/C Statistic (95 % CI)	0.82 (0.81, 0.83)	0.77 (0.76, 0.77)	0.79 (0.78, 0.80)	0.79 (0.79, 0.80)	0.78 (0.77, 0.79)
Organization level					
Covariance (95% CI)	0.040 (-0.02, 0.10)	0.018 (-0.019, 0.055)	0.19 (-0.12, 0.49)	0.01 (-0.013, 0.034)	–
SE	0.032	0.019	0.15	0.012	–
ICC	0.012	0.005	0.053	0.003	–
MOR (95% CrI)	1.22 (1.00, 1.37)	1.14 (1.00, 1.26)	1.52 (1.00, 1.97)	1.10 (1.00, 1.20)	–
Home level					
Covariance (95% CI)	0.27 (0.18, 0.35)	0.35 (0.25, 0.45)	0.32 (0.22, 0.42)	0.12 (0.077, 0.16)	0.56 (0.33, 0.78)
SE	0.043	0.052	0.052	0.021	0.12
ICC	0.075	0.097	0.089	0.035	0.14
MOR (95% CrI)	1.65 (1.52, 1.78)	1.78 (1.63, 1.93)	1.74 (1.58, 1.89)	1.40 (1.31, 1.48)	2.06 (1.75, 2.37)
Unit level					
Covariance (95% CI)	0.048 (0.010, 0.09)	0.071 (0.034, 0.11)	0.066 (0.028, 0.10)	–	0.41 (0.34, 0.49)
SE	0.0192	0.019	0.019	–	0.038

ICC	0.014	0.021	0.020	–	0.111
MOR (95% CrI)	1.24 (1.10, 1.33)	1.30 (1.20, 1.38)	1.28 (1.18, 1.37)	–	1.87 (1.76, 1.97)

Bold items indicate significant 95% confidence intervals.

ABS = Aggressive behaviour scale, ADL = Activities of daily living scale, CHESS = Change in health, end-stage disease, and signs and symptoms scale, CPS = Cognitive performance scale, DRS = Depression rating scale, CVA = Cerebrovascular accident, CHF = Congestive heart failure, CVD = cardiovascular disease, AUC = area under the curve, CI = confidence interval, SE = standard error, ICC = intraclass correlation coefficient, MOR = median odds ratio, CrI = credible interval

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CHAPTER SIX

Discussion

Summary of Main Findings

As Canada's population ages and the demand for LTC services increases significantly, ensuring high-quality medical care for complex LTC residents has become a healthcare priority. This thesis addressed key gaps in our understanding of physicians who practice in LTC and their effect on care quality. The nursing home specialist model,^{1,2} within a broader conceptual framework, guided this thesis by understanding how three interconnected dimensions (commitment, competence, and medical staff organization) interact to influence the quality of medical care in LTC practice. My research primarily focused on commitment, while recognizing the wider practice context in which physician practice occurs. This thesis involved collecting and analyzing both primary and secondary data, with the related studies informing each subsequent chapter directly. Through comprehensive, interconnected, and multi-method research, this work enhanced both theoretical understanding and practical application of physician commitment, while also revealing complex factors in the LTC practice environment (Figure 1). The findings are valuable for researchers, healthcare providers, medical educators, and policymakers aiming to improve care quality and outcomes in LTC settings.

The foundational study in Chapter 2 developed three feasible ways to measure LTC physician commitment within existing health administrative databases, and revealed variation in commitment levels as well as mixed associations with resident outcomes. Examining the practices of LTC physicians has not been widely explored in

Summary of Findings in Understanding LTC Physician Practice Across Studies

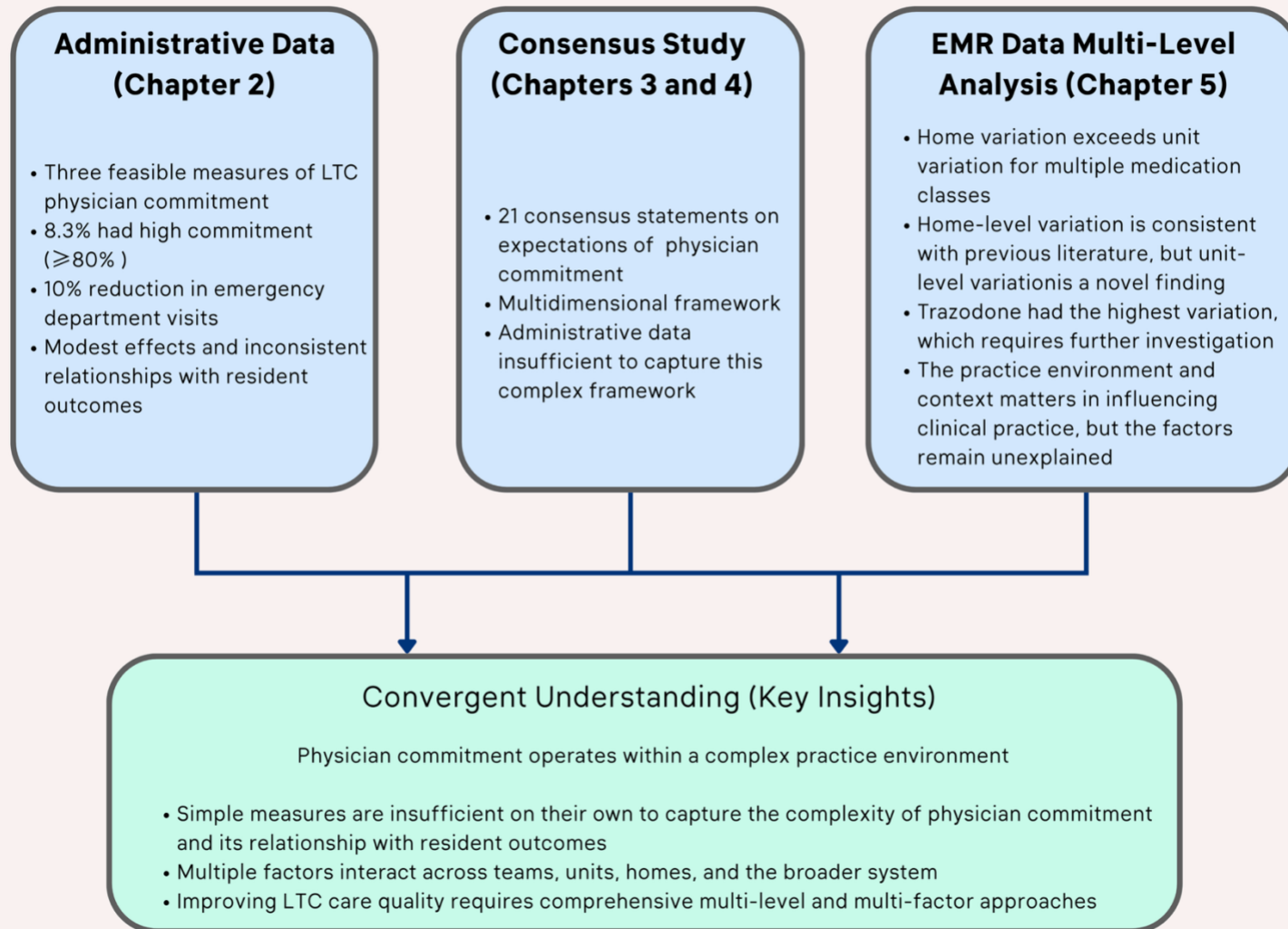


Figure 1. Summary of Findings of LTC Physician Practice Across Studies

the Canadian context; therefore, this study was the first population-level investigation of physician commitment to LTC practice. Specifically, I found that only 8.3% of physicians had a high commitment ($\geq 80\%$ practice commitment) to LTC, with the clear benefit being a 10% reduction in ED visits for residents under their care. However, the inconsistent relationships between commitment measures and other resident outcomes highlighted the limitations of administrative approaches in capturing the full complexity and multiple aspects of physician commitment. The findings provided new evidence from the Canadian context, emphasized the limitations of administrative measures, and demonstrated the inherent complexity of the practice environment. These results directly supported subsequent studies, where I established a consensus-based definition of physician commitment and explored how the practice environment influenced prescribing behaviour.

The rigorous modified e-Delphi study I led in Chapters 3 and 4 generated 21 statements on a multidimensional understanding of expectations of physician commitment in LTC. The framework covered time allocation, in-person presence, interdisciplinary collaboration, clinical care approaches for medication management and palliative care, accessibility to staff, and ongoing competency development. Notably, the expert panel rejected metrics that are easily measured in administrative databases, such as the number of LTC homes served, years of experience, and specialized certifications or training, as indicators of commitment. This study confirmed the finding in Chapter 2 that administrative measures inadequately capture the complexity of commitment in practice, as further illustrated by one expert's observation that having residents as 5% of a physician's overall caseload could require 20% of work time due to

the intensity of LTC care. Unfortunately, administrative measures in Ontario cannot account for the time dedicated to LTC resident care. The alignment between the population-level findings and the expert consensus framework not only highlighted the importance of moving beyond simplistic billing-based measures but also validated the theoretical premise that commitment is more complex than traditional administrative measures suggest. While administrative data revealed patterns of practice variation, the consensus framework laid the conceptual groundwork for understanding what constitutes meaningful expectations of commitment in LTC practice.

For the research conducted in Chapter 5, I aimed to investigate how the LTC practice environment and organization of care, beyond individual physician characteristics, influenced medication prescribing patterns, which are key indicators of medical care quality in LTC settings. The innovations in this study were twofold: (1) the analysis considered four levels (resident, unit, home, and organization), whereas most other studies consider only two (resident and home); and (2) it demonstrated the use case of using novel EMR data directly from LTC homes to facilitate quality improvement initiatives at the point of care. The findings revealed substantial unexplained variation in both psychotropic and non-psychotropic medications, with home-level variation consistently exceeding unit-level variation across all medications examined. This demonstrated how the organizational practice environment within which committed physicians practice can either support or hinder their ability to deliver optimal care. The high variation in trazodone is particularly significant for LTC clinical practice, given existing documentation highlighting the widespread off-label use of trazodone and its substitutions for antipsychotics, with evidence suggesting limited benefit and safety

concerns.^{3–11} This study showed that prescribing decisions are influenced by unexplained factors at the unit and home-levels, which may include local practice patterns, clinical decision-making processes, and the culture, rather than solely by resident characteristics. The absence of significant organization-level variation does not indicate no influence, as our data were underpowered at the organizational level to detect differences meaningfully.

Together, these studies offer an integrated understanding of physician practice in LTC, highlighting the complex interactions between physician commitment, the LTC practice environment, and quality of care outcomes. The research showed that although physician commitment influences certain outcomes to some degree, it functions within a broader system of factors, including team dynamics at the unit level, culture and policies at the home level, and the availability of infrastructure and resources to support evidence-based care approaches. These interconnected findings provide important contributions to the existing literature on physician practice in LTC settings. The convergence across the different methodological approaches strengthens confidence in the conclusion that improving LTC care quality requires comprehensive approaches addressing individual, organizational, and systemic factors simultaneously. The administrative data revealed the limitations of simple measures, the consensus work demonstrated the complexity of meaningful expectations of commitment, and the EMR analysis showed how context shapes clinical practice, which all together provide a comprehensive picture of the challenges and opportunities in optimizing physician practice in LTC settings. To fully understand the significance of these contributions, it is important to situate the findings within the broader literature on LTC physician practice.

Comparison of Findings with Relevant Literature

Each chapter in this thesis includes specific comparisons to relevant literature; however, the broader comparisons across this thesis warrant further discussion. This thesis makes significant contributions to the theoretical understanding of LTC physician practice by operationalizing and extending aspects of the nursing home specialist framework within the Canadian context. While previous research has examined individual components of the nursing home specialist model in discrete studies, this work represents the first comprehensive investigation in Canada of how LTC physician practice influences care quality through innovative multi-method approaches.

The commitment dimension was extensively examined in this thesis across Chapters 2 to 4. This thesis investigated whether physician commitment, as measured through administrative databases, affects quality of care outcomes and found a reduction in ED visits but no reduction in the use of any medication prescriptions or any hospital admissions. While a 10% reduction in ED visits is statistically significant, the clinical significance of this finding warrants careful consideration. This modest effect size, while meaningful at a population level, suggests that physician commitment alone has a limited direct impact on resident outcomes. The marginal nature of this association aligns with the complex, multifactorial determinants of care quality in LTC settings, where resident characteristics, staffing patterns and competence, organizational culture, and system-level factors all contribute to outcomes. Our limited results may reflect several important realities: first, that baseline care quality among LTC physicians in Ontario may already be relatively high regardless of commitment; second, that administrative measures of commitment, while novel and feasible, may not

capture the most clinically relevant aspects of physician engagement; and third, that meaningful improvements in LTC resident outcomes likely require coordinated interventions addressing multiple levels of the care system simultaneously rather than solely focusing on any one element.

Our findings contribute to the broader literature on the impact of physician practice on LTC residents. Most of this research originates from the U.S., which examines ‘SNFists’ based on the definition that 80 or 90% of a physician’s billings are devoted to residents of skilled nursing facilities.^{12–16} The ‘SNFist’ definition can be considered to describe a greater commitment to care, but it misses the components of competence and medical staff organization.¹⁷ Studies have found that care from ‘SNFists’ has resulted in lower rehospitalizations or fewer avoidable hospitalizations,^{12,14} lower hospital transfers in the last days of life,¹⁵ lower use of indwelling catheters,¹⁸ reduced prolonged medication use of potentially harmful medications,^{18,19} more successful discharges to the community setting,¹² and lower odds of ED visits and hospitalizations for ambulatory care sensitive conditions.²⁰ Although our Canadian data did not yield similar positive results, it is essential to consider several contextual and methodological distinctions that may explain the differences in the findings. Some studies from the U.S. are based in skilled nursing facilities (SNFs), which provide more specialized care for post-acute or short-stay patients, with the goal of providing short-term, intensive medical and rehabilitation services to facilitate discharge back home.^{12,21,22} A recent study found no relationship between a clinician’s panel size (i.e., the number of patients) and outcomes for post-acute patients.²³ Other studies focus on long-stay patients, who are similar to Canadian LTC residents, but use more specific

outcomes, such as duration of medication use, appropriateness of prescriptions, or alignment with existing guidelines for inappropriate medications, as well as specific instances of hospitalization (e.g., during end-of-life or identifying avoidable hospitalizations).^{14,15,19} Another study considered the presence of each additional nursing home specialist at a regional level, rather than individual physician practice, and it is important to note that the influence of physicians across studies have shown a relatively small influence on resident outcomes similar to our study.^{14,15,18,19} The modest effects observed across studies suggest that while physicians play an important role in LTC practice, there is underlying complexity in the relationship, such as team dynamics and processes of care that influence outcomes, and the healthcare delivery context significantly moderates these relationships. The differing practice context in the U.S., including the Five-Star Quality Rating System, which rates NHs from 1 (worst) to 5 (best) to measure care quality,^{24,25} may explain the different findings in this thesis. These contextual differences highlight the importance of developing measurement approaches and frameworks that are aligned with the Canadian LTC environment and practice context. Certain outcomes in the Canadian context warrant further investigation, such as examining the quality of death and end-of-life care, the use of specific medical therapies (e.g., indwelling catheters), and avoidable transfers and potentially inappropriate medications.

The work in Chapter 2 revealed that traditional conceptualizations of commitment, based primarily on proportions from administrative databases, although necessary, are insufficient to capture the complex nature of physician commitment. I demonstrate, with the consensus of an expert panel (Chapters 3 and 4), that

expectations of physician commitment also encompasses time spent, the quality of interactions, physician availability, physician accessibility to staff, engagement with interdisciplinary teams, and dedication to ongoing competency development. The consensus framework developed within this thesis provides a more comprehensive understanding than previous operationalizations of commitment in the literature. Existing literature suggests that these other dimensions of commitment improve care quality, such as more physician presence in a home associated with improved pain management or fewer potentially avoidable hospitalizations,^{26–28} more physician availability reduced transfers to the ED or hospital,^{29,30} physicians dedicated to LTC units led to reduced ED transfers and improved care continuity,³¹ and discontinuous relationships with the primary clinician increased hospitalizations for ambulatory care sensitive conditions.³² These findings align with the multidimensional consensus framework I developed and support the need for additional primary studies or improved data sources for secondary studies to investigate how physician presence, availability and dedication to specific units, and/or physician time per resident impact care quality in Canadian LTC residents.

The competence dimension of the nursing home specialist model, although not explicitly examined in the current studies, emerges as an underlying skill required for LTC physicians, closely intertwined with commitment and represents an area for future research. While the expert panel emphasized that specialized certification alone does not indicate commitment, the underlying assumption is that committed physicians must possess the knowledge and skills necessary to deliver high-quality medical care. The thesis findings suggest that competence may be developed through multiple pathways

beyond formal training and certification, as evidenced by the expert panel's assertion that specialized certification does not imply that a physician is more or less committed to LTC practice. This aligns with the fact that family practice training and other CACs do not have specific training standards or requirements in LTC medicine,^{33–35} suggesting that competence may be developed through experience, mentorship, and continued learning rather than through traditional credentialing processes alone. Competency has received considerable attention from several countries and the World Health Organization, with a focus on strengthening medical care provision in LTC and the need for quality metrics specific to the physician.^{36–43} While recent work has pilot-tested a set of quality measures in North American LTC homes, additional work is needed to define, operationalize, test, and validate the measures within the EMR database before widespread data collection, reporting, and research can be done.^{44,45}

The final dimension, medical staff organization, was not explicitly examined but illuminated through the multi-level analysis in Chapter 5, which demonstrates how the practice environment at the unit and home levels significantly influences clinical practices such as medication prescribing. Although this thesis was limited in its ability to identify specific medical staff models in the EMR database, it is informed by the knowledge that physicians working in Ontario LTC homes are typically assigned at the unit level and that LTC homes are legislated to have a presence of a medical director to oversee medical services, who must have completed an associated course.^{46–48} I found that unexplained factors at the unit or home matter more than system-wide policies and resident characteristics, supporting factors such as clinical decision-making, practice patterns, team dynamics, and prevailing culture as potential drivers of care quality.

These findings align with previous research that supports the importance of structured medical staff organization. Medical staff organization surveys have demonstrated relationships between organizational structure and outcomes such as restraint use, pneumococcal vaccination, and reduced ED visits or rehospitalizations.^{49–52} Additional research has found that structured appointments of dedicated LTC physicians (i.e., a “closed” staff model), instead of community physicians following individuals admitted to LTC (i.e. a “open” staff model), reduced preventable hospitalizations and readmissions, and improved collaboration and communication mechanisms by reducing telephone/electronic communication.^{26,30,53–55} The number of physicians caring for LTC residents within a home has also been found to affect outcomes, with a lower number of physicians being more advantageous, but not a solo physician caring for all residents within a home.^{51,56} In terms of medical directors, limited Canadian data exist beyond preliminary survey data, which finds that most medical directors spend less than two hours per week.⁴⁶ Anecdotal reports suggest that over 25% of homes in Ontario have vacancies. In the U.S., over one-third of homes lack a medical director, and for those that do, they spend more than 4 hours per week.⁵⁷ Another study has found that improvements in quality occur when medical directors are involved.⁵⁸ In totality, these findings highlight the need for future research to examine the specific medical staff and team structures at the unit and home levels in Canada to understand how they may impact variations in care quality.⁵⁹

The findings from this thesis can be considered in relation to the Dutch care model and the nursing home specialist model. The Dutch elderly care physician model combines three years of specialized training, encompassing all three dimensions of the

nursing home specialist model: ensuring high competence through structured education, fostering commitment through dedicated practice focus, and establishing clear medical staff organization through a specialized role.^{17,41,60,61} While the Dutch model shows promise theoretically, there is little to no evidence preventing definitive comparisons. The integration of multiple dimensions within the Dutch approach aligns with the finding in this thesis that commitment alone produces modest effects, suggesting that comprehensive approaches addressing competency and organization simultaneously may be necessary for substantial quality improvements. This aligns with the theoretical premise that the three dimensions of the nursing home specialist model (commitment, competence, and medical staff organization) work synergistically rather than independently (Figure 2). A synergistic relationship may explain why single-dimensional measures of physician practice yield modest effects in LTC settings. When commitment operates in isolation, without corresponding competence in geriatric care principles and support organizational structures, its impact on resident outcomes remains limited. The 10% reduction in ED visits that was observed in this thesis likely represents the ceiling of what commitment alone can achieve without complementary information on clinical skills and care organization. This finding validates the model's conceptualization of nursing home specialist practice as multidimensional and interdependent, where the full benefits are likely to emerge when all three dimensions are optimized simultaneously. Interventions targeting only physician dedication, without addressing potential knowledge gaps or organizational barriers, will likely produce incremental rather than transformational improvements in care quality. Future research should investigate interaction effects, examining whether highly committed physicians

The Nursing Home Specialist Model: Findings from the Canadian LTC Context

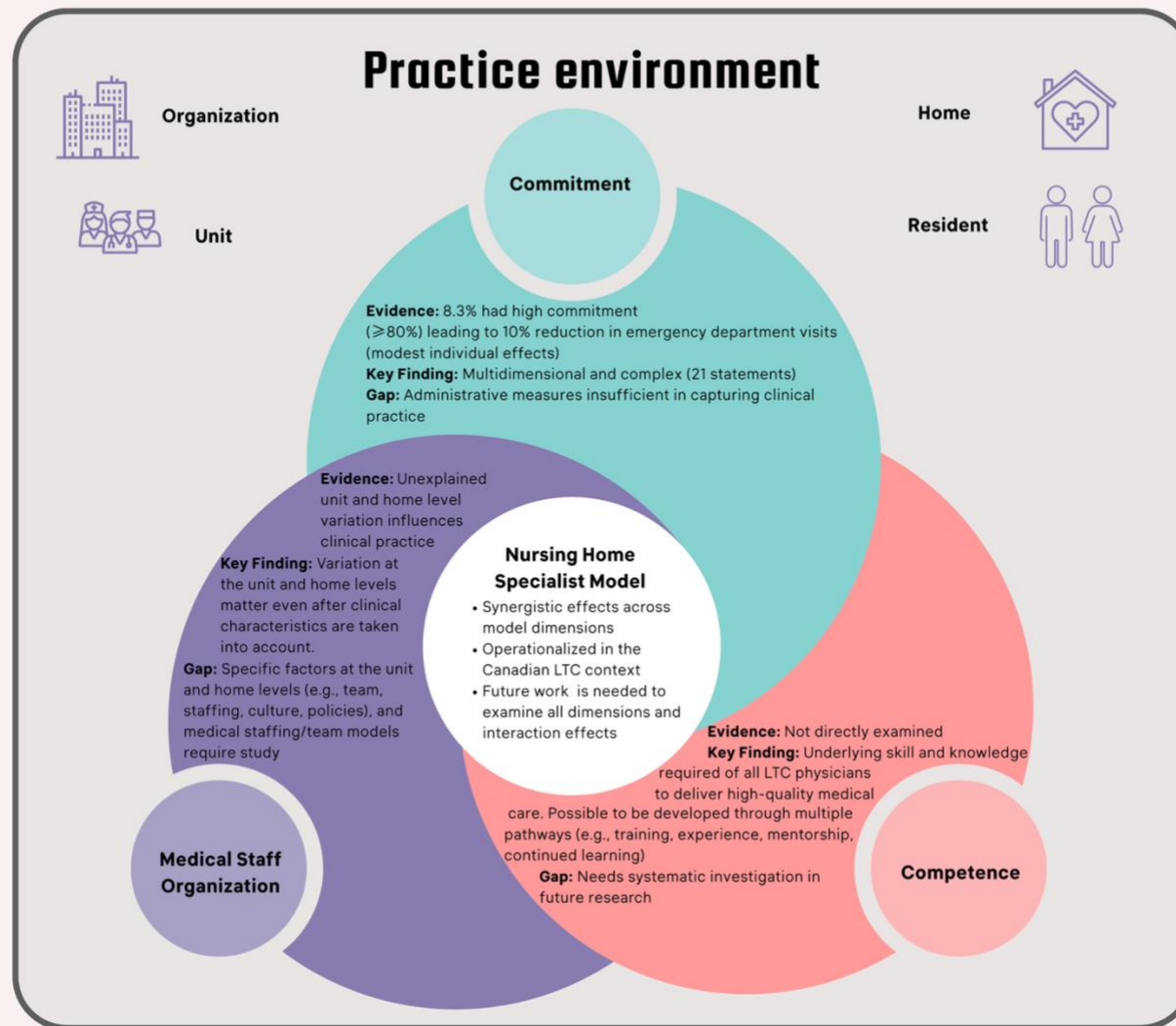


Figure 2. The Nursing Home Specialist Model: Findings from the Canadian LTC Context

achieve better outcomes in well-organized care environments or whether competent physicians have a greater impact when supported by committed colleagues and a structured medical staff organization.

Implications of Thesis Findings

This thesis presents valuable implications for researchers, healthcare providers, medical educators, and policymakers in LTC. I developed an approach to quantify physician commitment and discovered that only 8.3% (n=114) of 1,368 Ontario LTC physicians had at least 80% practice commitment, associated with a 10% reduction in ED visits. Since other outcomes examined indicate that LTC physician commitment did not distinguish care quality substantially, it suggests that LTC physicians provide adequate care for LTC residents regardless of their level of commitment, based on the selected metrics. This finding requires careful interpretation for medical educators and practicing physicians, as while it suggests baseline competence among LTC physicians, the modest effects could also reflect the greater volume of care provided by the interdisciplinary care team that make physician differences less detectable in population-level outcomes, even though still valuable. For individual residents and caregivers, a 10% reduction in ED visits may represent meaningful improvements in care continuity and reduced trauma associated with transfers. For LTC homes and healthcare systems, this magnitude of effect across the population could translate to substantial resource savings and improved capacity management. For researchers and policymakers, these results highlight the incremental nature of quality improvement in complex healthcare settings and the need for realistic expectations when implementing physician-focused interventions. All stakeholders should be mindful that there is

inherent complexity and other variables may be at play, like the impact of factors such as physician experience, workload intensity, practice in multiple care settings, additional training and practical experiences, and other dimensions of commitment, which were not possible to analyze in administrative databases, which may impact care quality. The results are also valuable for policymakers, as the population-level insights into workforce patterns can inform workforce planning, resource allocation, and policy development, identifying areas that require targeted support. Policymakers should recognize that targeting physicians alone or single-factor solutions are unlikely to produce dramatic improvements in LTC resident outcomes, but sustainable quality improvements will require coordinated, multi-faceted interventions. This does not diminish the importance of physician commitment, but physicians must be supported by robust systems and adequate resources to achieve their full potential impact on resident care quality. Policies should simultaneously address workforce development, organizational culture, staffing adequacy, infrastructure for non-pharmacological interventions, and system-level support for evidence-based care practices. Our work also provides a template for additional research, as our methodological innovation enables systematic evaluation of physician practice patterns and can be replicated in other jurisdictions to enable comparative studies and longitudinal analyses. This methodology can also be adapted to examine other provider types or practice contexts.

The consensus framework I created represents the first, evidence-based, multidimensional framework for LTC practice. Medical educators can use this framework as guidance for curriculum development and competency assessment aligned with expert-identified priorities that are grounded in real-world LTC practice. The

domains identified as important by the panel can be aligned with training experiences to ensure graduates are prepared for the realities of LTC practice. Educational programs should emphasize the unique aspects of LTC practice, including palliative care and end-of-life care approaches, medication management in frail, complex populations, and effective communication with interprofessional teams. In contrast, physicians currently practicing in LTC or entering LTC practice can use this as a guide, providing clear expectations for meaningful engagement in LTC. It helps physicians understand that commitment encompasses other elements, such as quality interactions, team collaboration, and ongoing learning, which can guide physicians in structuring their practice to maximize their impact, avoid burnout from unrealistic expectations, and inform professional development decisions. For policymakers and regulatory bodies, the framework offers an evidence-based foundation from expert LTC physicians for developing standards, policies, and guidelines related to LTC medical practice to encompass the multidimensional nature of LTC practice. This is particularly relevant given the focus on standards in LTC since the COVID-19 pandemic.^{62–64} Additionally, this study emphasized that elements of physician commitment should be supported through reimbursement structures and policy incentives, rather than focusing solely on volume-based metrics, enabling physicians to practice effectively within team-based care models. Current remuneration models may not adequately compensate physicians for the intensive, relationship-based care that characterizes high-quality LTC practice.⁶⁵

This thesis contributed evidence that home-level variation consistently exceeds unit-level variation across medication classes, suggesting that LTC homes and administrators should consider the importance of within-home culture, policies,

leadership, and staffing dynamics as shaping clinical practice and the need for evidence-based decision-making. This suggests that LTC residents and caregivers should carefully consider multiple factors when making care decisions, including the culture, policies, and practices of the LTC homes, as well as the provision of medical care. However, the practical reality of LTC placement decisions, which are often made during crisis situations with limited time, highlights the need for more transparent and accessible quality reporting that could help families make informed decisions despite constraints. When considering quality improvement initiatives, LTC homes should focus not only on individual providers but also on unit and home levels to address existing prescribing practices and support deprescribing initiatives and non-pharmacological approaches, with adequate infrastructure, including staffing, training, and clear protocols. At the health system level and for policymakers, the findings suggest that solely targeting particular medication classes (i.e., antipsychotics) as a quality metric is insufficient because prescribing decisions involve complex clinical judgments with multiple competing considerations that vary by individual residents and the care context. Prescribing appropriateness is inherently subjective, and indicators of quality do not capture the nuanced clinical decision-making process. Policymakers should consider capacity building and broader reporting strategies that are adaptable to local needs and improvements, rather than relying solely on the enforcement of regulations or reporting requirements. This research supports the implementation of comprehensive medication monitoring systems and the investment in infrastructure to support non-pharmacological approaches to behavioural management.⁶⁶

From a theoretical perspective, this thesis operationalized the nursing home specialist model within the Canadian context, demonstrating how commitment, competence, and medical staff organization interact to influence care quality. This advancement provides insights into physician practice based on the context of Canadian LTC medical practice, bounded by contextual regulations and funding models. The work offers researchers a foundation for future studies and can guide hypothesis development in complex healthcare settings such as LTC. It also emphasizes to policymakers that physician practice requires attention to multiple interconnected dimensions rather than single-focused policy decisions. A fundamental tension in healthcare policy is between standardization and individualization, and future policy development will need to recognize this tension by creating frameworks that establish minimum standards while preserving space for clinical judgment and person-centred care approaches that reflect individual resident needs and preferences. The COVID-19 pandemic brought LTC into the spotlight as an area needing support, workforce planning, and system reform;⁶² system design and reform effects should recognize the complex relationships between physician characteristics, practice environment, organizational structures, and care processes that collectively impact care outcomes. Collectively, the contributions of this thesis enhance understanding of LTC physician practice, while providing practical guidance for medical educators, healthcare providers, and policymakers. The research demonstrates that optimizing physician practice necessitates comprehensive approaches that address individual, organizational, and systemic factors simultaneously.

Strengths and Limitations

This thesis exhibits several methodological strengths and novel contributions, and limitations as discussed within each respective chapter. Here I discuss those which are common across the studies.

The sequential multi-method approach used in this thesis enabled a comprehensive investigation of the complexity of LTC physician practice, while allowing each study to inform and improve additional investigations. The progression from population-level administrative data to expert consensus methodology to EMR data provided multiple perspectives on physician practice and care quality that would not have been possible with any single approach. Different methodological strategies were integrated to address the complexity of the research area and build cumulative knowledge on medical practice in LTC. The health administrative data enabled population-based designs with large sample sizes, collecting information for all eligible persons, which enhanced the generalizability of findings and reduced the selection biases associated with smaller, single-site studies.^{67–70} The development of novel metrics of commitment using administrative data creates opportunities for replication and adaptation in other jurisdictions with similar data sources. The consensus methodology used rigorous procedures following established guidelines (ACCORD and RAND).^{71,72} It achieved exceptional interest and participation rates, lending credibility to the framework development that can be applied across diverse practice contexts and data sources. The multi-level analysis approach, utilizing single-vendor EMR-based data, represents a significant innovation and offers unprecedented granularity in understanding how the LTC practice context influences clinical practice. This approach

provides a model for leveraging EMR data to support extensive research, enhancing quality improvement and learning health system initiatives across Canadian LTC settings.

Despite these many strengths, several limitations warrant acknowledgement and suggest directions for future research. This thesis primarily focused on the commitment dimension of the nursing home specialist model, reserving the investigation of the other dimensions for future studies in the Canadian context. This thesis was conducted primarily in Ontario, Canada, which may limit generalizability to other Canadian provinces and territories, given the decentralized Canadian model with different healthcare delivery systems or to other international contexts with alternative models of LTC medical care delivery structures, regulatory frameworks, and funding models. The secondary data used was not generated for research purposes and could only examine physician practice information readily available in administrative data.^{70,73} The observational nature of the commitment study limited our ability to establish causal relationships, and unmeasured confounders may explain the modest associations observed. For instance, physicians with more commitment may systematically differ in ways not captured by administrative data, such as communication skills, clinical decision-making approaches, or relationships with interdisciplinary staff. Further, residents cared for by committed physicians may differ in unmeasured ways that influence outcomes, such as family involvement, care preferences, and illness trajectories. The administrative data, while providing population-level coverage, could not capture important qualitative aspects of physician practice, such as communication quality, family/caregiver engagement, or the appropriateness of clinical decisions. The

innovative EMR analysis was limited in that it could not attribute prescribing decisions to specific physicians or assess the clinical appropriateness of medication use.

Additionally, the outcomes examined in this thesis may not capture the full range of outcomes valued by residents, caregivers, and care teams. The consensus framework development, while rigorous, captured only physician perspectives on commitment.

Next Steps in Program of Research

These methodological strengths and limitations of this thesis inform several important directions for future research and practice development.

Expanding and validating the commitment framework are priorities for future research. The developed consensus framework should be examined for other stakeholder perspectives on physician commitment, including other care professionals, LTC residents, and caregivers. Understanding how different stakeholders prioritize commitment could reveal differences between professional expectations and care recipient values, potentially identifying aspects of physician practice that matter most for residents and caregivers, but are not captured in physician-focused frameworks. This may be done through separate consensus processes or mixed-methods approaches that compare physician expectations of commitment with resident-reported experiences of physician availability, communication quality, and care coordination. The framework can also be examined to see how it may vary in other jurisdictions and healthcare systems. Comparative research in other jurisdictions may provide insights into best practices and inform policy development. This framework requires the development and operationalization of the concepts for future measurement and evaluation of how the consensus-based framework influences care quality. Additionally, mixed-methods

approaches would be particularly valuable in combining quantitative measurements with qualitative experiences of physician practice and their impact on resident and caregiver experiences. Future research should investigate whether physician commitment shows stronger associations with resident-reported outcomes, family caregiver satisfaction, care team functioning, or quality-of-life measures not captured in administrative data.

Future research would benefit from developing more sensitive and clinically relevant measures of physicians' engagement that better predict meaningful resident outcomes. This includes investigating dose-response relationships for specific aspects of commitment (e.g., time spent per resident, frequency of in-person visits) and targeted clinical outcomes. Mixed-methods approaches combining quantitative outcome measurement with qualitative assessment of physician-resident relationships, care team dynamics, and clinical decision-making processes may better capture the mechanisms through which committed physicians influence care quality. Additionally, natural experiment designs, such as examining outcomes before and after changes in physician assignment or commitment levels, could strengthen causal inference. Intervention studies testing whether enhancing specific dimensions of commitment (e.g., increasing on-site presence, improving team integration) leads to improved outcomes would provide more definitive evidence of causal relationships and inform targeted quality improvement efforts.

Extending this research to other healthcare providers in LTC will be essential as care models evolve to include more diverse provider types. Understanding how commitment frameworks apply across disciplines will be important for optimizing team-based care approaches, and it may be worthwhile to explore team-based commitment

to capture the collective engagement of teams that may reflect the collaborative nature of LTC care delivery. Physician extenders (i.e., nurse practitioners, physician assistants) have gained recognition as primary care providers in the U.S. NHs;^{16,74} however, this remains an emerging model in the Canadian context.^{75–77} Nurse practitioners are expanding in Canadian LTC homes, raising important questions about role clarity and optimal care models. For example, current debates in the Ontario legislature, Canada, are considering whether nurse practitioners can also serve as LTC medical directors.^{78,79} Unfortunately, administrative data sources are unable to identify LTC medical directors within the system and do not capture the practice patterns of LTC nurse practitioners beyond medications ordered, as nurse practitioners do not submit billings, unlike physicians.⁸⁰ Data from health administrative databases will be procured to examine prescribing patterns of nurse practitioners in LTC, while future work will leverage the OnSPARK EMR database to identify both nurse practitioner and physician practice patterns. Additional work will be needed to examine the practices of LTC medical directors and nurse practitioners, as well as their impact on care quality, particularly as data sources evolve.

Lastly, investigating other dimensions of the nursing home specialist model will complete the examination of the theoretical framework in the Canadian context. As the OnSPARK EMR database expands, future investigation warrants developing algorithms to identify the most responsible physicians; operationalizing, testing, and validating physician-specific quality measures with the database; linking specific actions to physicians and clinical indicators to better understand factors influencing clinical

practice; and bringing other medical staff organization, and unit and home-level data from LTC homes to examine simultaneously with resident EMR data.

The findings of this thesis suggest that some of these actions can be implemented immediately in the near future, versus those requiring longer-term healthcare system reform. Immediately actionable items include leveraging the findings for workforce planning and implementing EMR-based metrics for real-time quality monitoring at unit and home levels. The longer-term initiatives will require sustained investment and system-wide changes, including coordination across medical educators, regulatory bodies, medical and nursing associations, and funding agencies to address systemic barriers to change. These items include developing specialized LTC training pathways or competency requirements for LTC medical practice, establishing funding models that adequately compensate for the intensive, relationship-based nature of LTC practice, clarifying the scope of practice and regulatory frameworks for nurse practitioners in LTC settings, and creating comprehensive quality measurement systems that capture the full spectrum of physician-sensitive outcomes.

Conclusion

This thesis provides a comprehensive understanding of physician practice and care quality in LTC settings through an innovative multi-method research program. Through sequential studies, this work advanced from measuring LTC physician commitment using administrative databases to developing evidence-based consensus frameworks and understanding the complex context of LTC practice that influences care delivery. The methodological contributions in this thesis provided templates for future research and established new pathways for investigating complex healthcare delivery in

diverse contexts. This thesis provides theoretical contributions by operationalizing the nursing home specialist model within the Canadian context for the first time. The integration of administrative measures of commitment, with a multidimensional understanding that encompasses the complexity of practice, within the multi-level practice context, provided a more comprehensive understanding of factors influencing care quality than previous research. This thesis also provides practical contributions by creating a consensus framework for medical education, workforce planning, quality improvement, and policy development, as well as actionable targets for interventions designed to improve care quality and reduce inappropriate medication use.

As healthcare systems worldwide grapple with aging populations and resource constraints, understanding how to optimize physician practice becomes critical for sustainable, high-quality care delivery. This thesis contributes knowledge for caring for vulnerable LTC residents who require skilled, committed, and well-supported physicians working within effective organizational structures. The framework and findings developed in this thesis provide a foundation for continued research and practice improvement efforts that can ultimately enhance the care experiences and outcomes for LTC residents across Canada and internationally. By providing the first evidence-based understanding of physician commitment and its relationship to care quality in the Canadian context, this thesis establishes a foundation for evidence-informed approaches to improving outcomes and experiences for residents, their caregivers, and healthcare providers. Future research should examine diverse perspectives on commitment, investigate physician competence and medical staff organization within LTC homes, and explore practice patterns of other healthcare providers in LTC.

Ultimately, this research represents a fundamental shift toward comprehensive, evidence-based frameworks that account for complexity in physician practice and provides practical pathways for developing more effective approaches to optimizing medical care quality in LTC settings.

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