

**Ontario Medical Schools' Contribution to a Socially Accountable Primary Care
Workforce: Associations with Pursuit of Extended Training and Practice in Rural or
Remote Areas**

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Preface

Saredo Mohamed Bouraleh was the principal author of the material presented in this thesis. She developed a detailed study protocol, which was approved by the School of Epidemiology and Public Health. The study design, including inclusion and exclusion criteria, was developed in collaboration with Dr. Claire Kendall, Dr. Daniel Myran, Dr. Steven Hawken, Sydney Persaud and Maya Gibb. Saredo Mohamed Bouraleh conducted the literature review, the analysis and wrote the manuscript-based thesis. Dr. Claire Kendall served as the primary supervisor for all components of the thesis. Dr. Kendall, along with Thesis Advisory Committee members Dr. Daniel Myran and Dr. Steven Hawken, provided crucial feedback and guidance throughout the project. All co-authors reviewed the manuscripts.

Ethics Review and Approval

This project received ethics approval from the Ottawa Health Science Network Research Ethics Board (Protocol ID: 20230194-01H) and the Bruyère Health Research Ethics Board (M16-25-019). The dataset was obtained through web scraping from the College of Physicians and Surgeons of Ontario's (CPSO) publicly accessible physician registry (<https://doctors.cpsso.on.ca/>). The registry includes the names of physicians, their registration class, specialty, practice address and other relevant regulatory information. Although the dataset contains identifiers (e.g., name, CPSO number), it does not include personal health information (PHI) as defined under the Personal Health Information Protection Act (PHIPA). Consent was not sought, as the data are publicly available. Following applicable ethical guidelines, individual consent is not required for research involving publicly accessible information.

Abstract

Background: This thesis examines how Ontario's medical schools contribute to the primary care workforce.

Methods: We used data from the College of Physicians and Surgeons of Ontario to conduct two cross-sectional cohort studies of the association between family medicine graduates' characteristics and our two outcomes: pursuit of extended training and practice in rural/remote settings.

Results: Between 1995 and 2021, 25.3% family medicine graduates pursued extended training. After adjustment, Queen's University graduates had significantly higher odds of pursuing extended training compared to NOSMU (males: OR=2.03; 95% CI: 1.31–3.16; females: OR=5.32; 95% CI: 3.48–8.14). Among 2263 recent graduates, 10.4% were practicing in rural/remote areas. Graduates from the University of Toronto (OR=0.12; 95% CI: 0.07-0.21) and McMaster University (OR=0.23; 95% CI: 0.14-0.38) had the lowest odds of practicing in rural/remote areas compared to NOSMU.

Conclusion: Findings underscore the need for policy and training reforms to support a socially accountable workforce.

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List of Abbreviations

AFMC: Association of Faculties of Medicine of Canada

CI: Confidence Interval

CMGs: Canadian Medical Graduates

CAPER: Canadian Post-M.D. Education Registry

CPSO: College of Physicians and Surgeons of Ontario

CFPC: College of Family Physicians of Canada

DME: Distributed medical education

EM: Emergency Medicine

FM: Family Medicine

IMGs: International Medical Graduates

NOSMU: Northern Ontario School of Medicine University

OCFP: Ontario College of Family Physicians

ORs: Odds Ratios

PG: Postgraduate

PGY-2: Postgraduate Year 2

PGY-3: Postgraduate Year 3

PCCF+: Postal Code OM Conversion File Plus

ROS: Return-of-Service

RSM: Root-Stem Model

SA: Social Accountability

SACtype: Statistical Area Classification Type

SCCT: Social Cognitive Career Theory

SGBA+: Sex- and Gender-Based Analyses

STROBE: Strengthening the Reporting of Observational Studies in Epidemiology

UG: Undergraduate

WHO: World Health Organization

Chapter 1: Introduction

1.1 Primary Care Crisis: Declining Access in Underserved Areas and the Shift Toward Focused Practice

A well-functioning healthcare system requires a strong primary care foundation to address the population's health needs (1,2). Extensive literature highlights the vital role of primary care in improving population health, emphasizing health promotion and disease prevention (3).

Compared to other areas of the healthcare system, such as specialty care, primary care also uniquely fosters health equity, a finding corroborated by studies conducted both within Canada and internationally (3). The Canadian healthcare system relies heavily on effective primary care to achieve the goals of the *Quintuple Aim*, a framework for transforming healthcare systems to improve health outcomes, enhance care quality, reduce costs, ensure workforce sustainability and promote equity (4,5).

Despite widespread recognition of the importance of primary care, Canada is currently amid a primary care crisis, with projections indicating a growing gap between patient needs and the availability of family physicians, particularly in underserved areas. In October 2024, the Ontario College of Family Physicians (OCFP) announced that 2.5 million Ontarians lack a regular family physician, with far more facing significant challenges in accessing timely appointments (6). Consequently, Ontario has experienced well-documented declines in access to primary care services, particularly in rural or remote communities (7–17). The primary care crisis disproportionately impacts underserved and marginalized populations, exacerbating existing inequities (18–22). For example, rural or remote communities in Ontario, where medical services are in high demand, face significant shortages of family physicians (23–25). Similarly, Francophone communities, especially in rural Northern Ontario, experience disparities in access to French-speaking family physicians (26–28). These inequities, driven by systemic barriers and geographic isolation, result in delayed care and worsened health outcomes for the affected populations (29).

At the heart of an effective primary care system lies comprehensive care, provided by a dedicated and robust family physician workforce (1,2). Comprehensive care encompasses a

range of essential primary care services, including health assessments, well-baby care and psychotherapy, provided longitudinally to a defined patient population (30). Comprehensive family physicians serve as the first point of contact for care, addressing the diverse needs of their practice populations, as opposed to those who provide most of their care in focused areas, such as emergency medicine or sports medicine (31–33). The management of complex health needs, the promotion of continuity of care and the fostering of long-term patient relationships by comprehensive family physicians have been demonstrated to result in improved patient outcomes and enhanced satisfaction (34). However, a longitudinal study by Lavergne et al. on family physicians practicing during the 1999/2000 and 2017/2018 fiscal years indicated troubling declines in comprehensive services across British Columbia, Manitoba and Nova Scotia (35,36).

While family medicine residents frequently express intentions to provide comprehensive care during their training, there is a growing shift toward focused practice upon graduation (37–39). In 2024, approximately 30% of family medicine residents completed extended training (i.e., postgraduate year 3 [PGY-3]) in domains such as emergency medicine and family practice anesthesia (40–43). In parallel, recent evidence has revealed that over 30% of early-career family physicians practice in focused areas, most commonly in emergency, hospitalist and addiction medicine (44). This finding aligns with earlier studies, which showed that in 2014/2015, only 67% of family physicians in Ontario provided comprehensive care, while 33% concentrated their practices in focused areas (45–47). This pattern raises concerns about the long-term sustainability of comprehensive family medicine, as increased pursuit of extended training programs is associated with the rise in focused practice (7,8,15,16,48–50).

1.2 Medical School Initiatives to Strengthen the Primary Care Workforce

Over the past two decades, social accountability has become a central mandate for medical schools. Social accountability is a “construct grounded in principles of social justice, in which citizens hold public institutions responsible for their activities and performance in addressing societal needs” (51–53). In the context of medical education, the World Health Organization (WHO) defines social accountability as “the obligation of medical schools to align their activities with the priority health needs of the communities they serve” (54). This definition has been adopted by Canadian medical education stakeholders, such as the Association of Faculties of Medicine of Canada (AFMC), which emphasizes the importance of training physicians equipped

to address diverse population health needs and reduce health inequities, especially in a time of increasing healthcare demands (54–60).

Ontario medical schools have implemented a range of initiatives to align with social accountability principles, including reassessing admissions policies, curricular design and training placements. Recently, admissions policies have been revised to increase access for applicants from rural, remote, low-income and other marginalized groups (61–64). These changes in admissions strategies are supported by evidence that students from underserved backgrounds are more likely to return to similar areas to practice as family physicians (65). Curricular reform has also emphasized equity-oriented and holistic principles of comprehensive primary care; an approach reflected in the philosophy and mission of Toronto Metropolitan University's forthcoming medical school (66). Finally, the expansion of distributed medical education and satellite campuses has broadened opportunities for students to train in diverse clinical settings (67). These placements provide hands-on experience in rural, remote and underserved communities, reinforcing medical schools' commitment to strengthening clinical competency and preparing graduates to serve priority populations.

A scoping review of Canadian studies aimed to understand the various factors that predict practice patterns among physicians (68). The review identified that training at specific medical schools and physicians' rural backgrounds were positively associated with rural practice (69), while other characteristics, such as sex/gender and age, showed mixed associations. Key gaps were identified, including limited data on predictors of practice in underserved areas outside rural communities and a lack of studies on specific sociodemographic characteristics, such as socioeconomic status and race/ethnicity, compared to U.S. studies (70). However, the studies reviewed were limited in scope, as most examined a narrow range of predictors, were not based on population-level analyses and did not capture outcomes such as the provision of comprehensive care. Although Canadian evidence is still emerging, American research provides additional insights. A systematic review of socially accountable initiatives within American undergraduate and postgraduate medical schools indicated their effectiveness in increasing the geographic distribution of comprehensive family physicians in underserved areas (71). At the same time, a recent cross-sectional study demonstrated that graduates from top-ranked U.S.

medical schools were significantly less likely to practice in low-income neighbourhoods, even among those in primary care (72).

1.3 Medical Education Stakeholder and System-Level Strategies that Influence the Family Medicine Workforce

Over the past decade, the College of Family Physicians of Canada (CFPC), responsible for certifying family physicians and establishing training standards, has implemented key educational reforms (73). These initiatives include the CanMEDS–FM and the Triple C Competency-Based Curriculum, both of which aim to strengthen training in comprehensive, community-based primary care (5–8). In recent years, the CFPC has introduced extended family medicine training programs, which offer an additional year of training in a specific area of focus across two distinct categories (78). These programs are intended to prepare family physicians to address evolving population health needs, particularly in underserved areas (9). The CFPC grants Certificates of Added Competence (CACs) to nationally accredited Category 1 programs, which include care of the elderly, palliative care, emergency medicine, family practice anesthesia, obstetrical surgical skills, addiction medicine, enhanced surgical skills, clinician scholar and sports and exercise medicine (80,81). Category 2 programs, also known as enhanced skills programs, consist of medical school-specific areas of focus beyond the CAC-recognized programs, such as enhanced maternal skills and oncology, developed to address local catchment needs (78). As these extended training opportunities, particularly in emergency medicine, have expanded considerably, important questions have emerged regarding the variation in the pursuit of these programs among Canadian medical schools. A 2016 cross-sectional study by Ross et al. identified substantial differences in the pursuit of extended training across institutions (82). These findings raise further concerns about the extent to which extended training aligns with current workforce needs, particularly in light of recent evidence. A report from the CFPC revealed that most Canadian family medicine graduates who pursue extended training programs tend to practice in large urban areas, rather than in rural or remote areas (83).

In addition, the Ontario government has implemented targeted policies to address physician shortages (84–86). One commonly used system-level strategy to address geographic maldistribution is the Return-of-Service (ROS) agreement. This approach requires International Medical Graduates (IMGs) to practice in a designated ROS-eligible area (i.e., any region outside

of Ottawa and the Greater Toronto Area) for five years following the completion of their residency training in exchange for financial support (84,87). While these policies aim to improve physician distribution and expand access to care in underserved areas, evidence suggests their long-term impact may be limited. Studies have shown that many IMGs do not stay in rural or remote areas once their obligations are completed (88–90).

1.4 Thesis Overview and Objectives

To ensure Canadian medical schools fulfill their social accountability mandates, it is essential to measure and track who they admit, who they train and where their graduates ultimately practice. However, traditional data collection methods (e.g., surveys) can be expensive, prone to low response rates and subject to various biases. Consequently, medical schools often lack the robust evidence needed to evaluate the effectiveness of their social accountability efforts. An innovative yet underutilized resource in healthcare research is provincial physician registry data, including the College of Physicians and Surgeons of Ontario (CPSO). Registration with the CPSO is mandatory for all practicing physicians in Ontario, including postgraduate residents and fellows. The CPSO dataset contains detailed information captured during registration and in annual mandatory renewal surveys, including a physician's sex, language, training (at undergraduate and postgraduate schools) and practice profiles (specialty and location of practice). Leveraging such population-level data offers an opportunity to evaluate medical schools' contributions to fostering a socially accountable primary care workforce.

In response to requests from key stakeholders in medical education, health workforce planning and advocacy, this thesis is part of a larger study designed to generate population-level evidence on the sociodemographic and educational characteristics of Ontario physicians and how these factors influence critical outcomes, including the distribution of physicians in the province and the representativeness of the physician workforce. Ultimately, this research aims to support data-driven policy changes that better align medical education with the health needs of communities, thereby promoting health equity in Canada.

1.4.1 Research Questions

The primary research question guiding this thesis is: To what extent do Ontario's medical schools contribute to a socially accountable family medicine workforce?

To further explore the broader implications of this thesis, the following sub-question is posed:
What sociodemographic and training characteristics of family physicians in Ontario are associated with pursuing extended training and providing care in rural or remote areas?

1.4.2 Thesis Objectives

The objectives of this thesis are to identify the predictors, among Ontario family medicine graduates, of the pursuit of extended training (Objective 1) and practice in rural or remote areas (Objective 2).

Chapter 2: Conceptual Framework

2.1 Introduction

This chapter presents the conceptual framework, grounded in social accountability principles, that guides this thesis. In this thesis, social accountability (SA) refers to “the obligation of medical schools to direct their education, research and service activities towards addressing the priority health concerns of the community, region and/or the nation they have a mandate to serve. The priority health needs are to be identified jointly by governments, healthcare organizations, health professionals and the public” (54). The conceptual framework examines the role of medical schools in addressing the primary care crisis, particularly concerning comprehensive care and access in rural or remote areas.

2.2 Conceptual Framework

In partnership with organizations, policymakers and communities, medical schools translate healthcare priorities into institution-specific SA strategies that may influence the primary care workforce. Developing a socially accountable medical education involves understanding the populations served, identifying priority health needs, and designing admissions pathways, curricular structures and training environments accordingly (51,52,55,59,60,72,91–93). Through these mechanisms, social accountability efforts may shape professional values and identities, contributing to workforce outcomes such as the pursuit of extended family medicine training or practice in underserved areas. At the same time, the distribution and composition of the primary care workforce are also shaped by broader contextual influences, including policy contexts (e.g., ROS agreements and College of Family Physicians of Canada training standards) and individual-level characteristics (8,48,68,94–104). Given data limitations, these factors are acknowledged as external contextual forces rather than primary components of this conceptual framework.

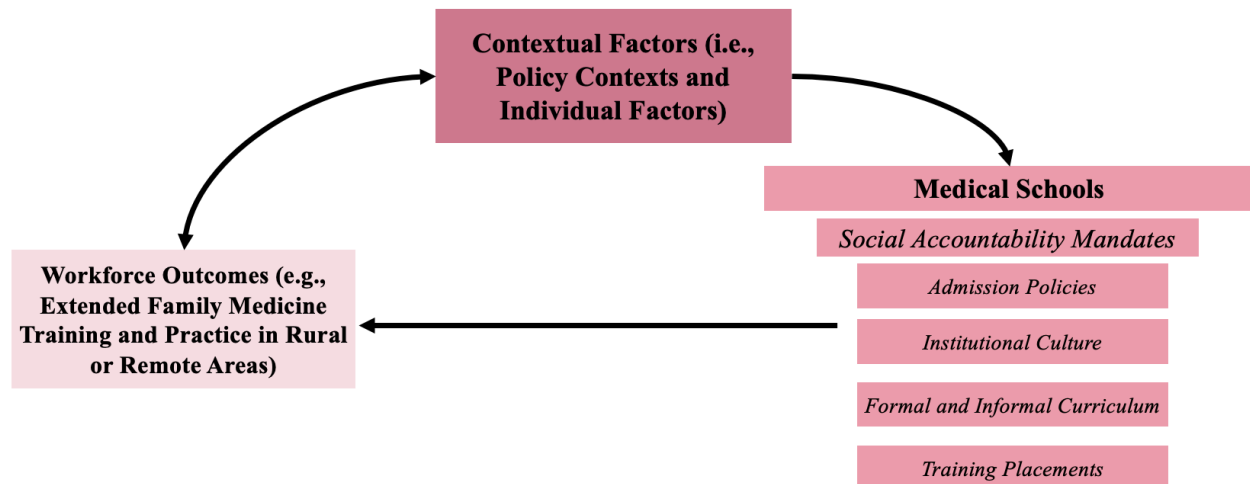


Figure 1. Conceptual Framework

2.3 Social Accountability in Medical Schools

Despite the variety of social accountability models described in the literature, four large-scale frameworks have emerged as fundamental in defining the values, principles and scope of social accountability in medical education. Boelen and Heck introduced the first model in 1995, emphasizing four key values (i.e., relevance, quality, cost-effectiveness and equity) (54). This initial framework aimed to address growing concerns about the disparity between health systems and population needs. In 2001, Health Canada released *Social Accountability: A Vision for Canadian Medical Schools*, reinforcing institutional responsibility for improving education, research and service delivery and calling for stronger collaboration with health care organizations, health professional groups, governments, policymakers and communities (59).

In collaboration with key partners, medical schools aim to tailor their social accountability mandates to the specific needs of the areas they serve, which may contribute to differences in educational environments and workforce outcomes. Building on this, Boelen and Woollard introduced the Conceptualization, Production and Usability (CPU) model, which offers a framework for evaluating how effectively medical schools align their actions with societal needs (C), translate these priorities into educational processes and programs (P) and ensure that graduates meaningfully contribute to improving population health and health system performance (U) (60). Finally, the Global Consensus for Social Accountability of Medical

Schools provided an internationally established framework which integrates social accountability principles into governance, partnerships, curriculum and accreditation processes (91).

While the implementation of SA mandates varies considerably across institutions, certain practices are commonly adopted. Through inclusive admissions processes, medical schools can cultivate a diverse and representative physician workforce that more accurately reflects the populations they serve. These social accountability efforts also involve the expansion of distributed medical education (DME) and satellite sites, providing trainees with hands-on experience in diverse clinical and community settings. Concurrently, institutional culture and curricula, plays a crucial yet often overlooked role in learners' values, career intentions and long-term commitment to practicing in underserved communities. To assess the long-term effectiveness of these initiatives, medical schools are encouraged to implement systematic evaluations. For instance, institutions could conduct rigorous, evidence-based research on regional healthcare access, quality of care and population health needs, as well as ensure ongoing monitoring of their graduate outcomes, such as practice location and scope of practice.

Nevertheless, addressing the primary care crisis requires considering a broader set of factors beyond the interaction between medical schools and workforce outcomes. To strengthen the primary care system, it is essential to recognize the physician workforce as a dynamic entity composed of diverse and interconnected components. These include government policies and training stakeholders (e.g., health workforce planning, funding and remuneration structures), medical schools (e.g., social accountability initiatives and institutional culture) and physician-level characteristics (e.g., sociodemographic background, personal values and life circumstances).

2.4 Conclusion

As emerging evidence suggests that the primary care crisis is likely to worsen over the next few years, this issue highlights the need for a comprehensive evaluation of medical schools responsible for maintaining the family medicine workforce. Although multiple external factors influence the primary care system, this framework offers a focused lens for understanding how elements within medical schools may shape workforce distribution and retention.

Chapter 3: Methodology

3.1 Study Design

We conducted two cross-sectional cohort studies to describe the distribution of physicians and their characteristics, as captured in the College of Physicians and Surgeons of Ontario (CPSO) dataset.

3.2 Data Sources

Our primary data source was the College of Physicians and Surgeons of Ontario (CPSO). To assess practice patterns, we linked physicians' primary practice postal codes to the Postal Code OM Conversion File Plus (PCCF+). Figure 2 provides a visual representation of the database linkage process.

3.2.1 *College of Physicians and Surgeons of Ontario (CPSO) Dataset*

The College of Physicians and Surgeons of Ontario (CPSO) dataset contains information on over 95,000 physicians, including basic demographic details, training background, registration status, specialty and practice location for all members registered since 1910. The data were compiled by investigators from the Ottawa Hospital Research Institute as part of the HELP MD initiative (Health Evaluation and Liveliness for Physicians through Meaningful Data). It includes completed records up to June 30th, 2022. Appendix A provides a comprehensive list of variables included in the dataset.

3.2.2 *Postal Code^{OM} Conversion File Plus (PCCF+)*

The Postal Code^{OM} Conversion File Plus (PCCF+) links postal codes to standardized geographic areas used in Statistics Canada's Census. PCCF+ is a SAS-based program, developed by Statistics Canada, designed to enhance geographic precision by integrating multiple data sources, including: Postal Code OM Conversion File (PCCF), a population-weighted postal code dataset, Geographic Attribute File and Health Region boundary files.

PCCF+ automates the assignment of postal codes to Statistics Canada's standard geographic areas and related identifiers. The program uses the most recent 2021 Census data to define geographic information based on provided postal codes. When a postal code corresponds to

multiple geographic regions, PCCF+ applies a population-weighted random allocation method to assign a single geographic area (105). Appendix B details all variables in the PCCF+.

The PCCF+ holds area-level characteristics such as the Statistical Area Classification type (SACtype), a widely used measure of rurality in Canadian health research. In cases where PCCF+ outputs were incomplete, we performed geospatial analysis using ArcGIS online, linked to the 2021 Census boundary file, to assign geographic classifications. Additional details on the geocoding approach are provided in Section 3.7.

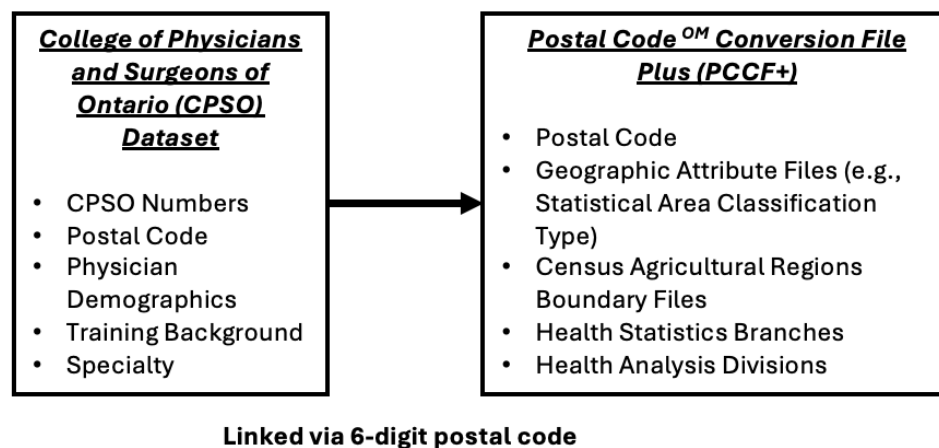


Figure 2. Database Linkage Diagram

3.3 Cohort Description

3.3.1 Inclusion Criteria

Objective 1: Extended Family Medicine Training

We included all physicians actively practicing in Ontario with a specialty in Family Medicine. Eligible family physicians, certified by the CFPC, must have obtained their independent practice license between July 1st, 1995 and July 1st, 2021. We selected July 1st, 1995, as the start of the study period, marking the elimination of the rotating internship program. This program had previously allowed medical graduates to complete a one-year internship to obtain licensure as general practitioners (106). The cohort was restricted to those who completed their core Family Medicine residency training in Ontario, including individuals who transferred into Family

Medicine from another specialty. Physicians were only included if they obtained their independent practice license within three years of completing their residency program.

Objective 2: Rural or Remote Practice

This cohort is a subset of the Objective 1 study population, comprising only physicians who obtained their independent licenses between July 1st, 2017 and July 1st, 2021. We selected July 1st, 2017, as the start of the study period to capture early-career IMGs fulfilling their ROS agreements.

3.3.2 Exclusion Criteria

For both cohorts, we excluded family physicians if they met any of the following criteria: held an expired membership with the College of Physicians and Surgeons of Ontario, were not actively practicing in Ontario at the time of data capture, had missing or invalid demographic information, had a recorded year of death and obtained an independent practice license in 2022, as the data extract occurred on June 30, 2022 and may not have fully captured physicians licensed later in the year.

3.4 Primary Exposures

Our primary exposures are undergraduate and postgraduate medical schools. Postgraduate medical school (PG) corresponds to the institutions where physicians complete their 2-year Family Medicine program. Undergraduate medical school (UG) refers to the institution where a physician obtains their medical degree. Medical schools included the following six institutions: University of Ottawa, University of Toronto, Queen's University, McMaster University, Western University (Schulich School of Medicine & Dentistry) and Northern Ontario School of Medicine University (NOSMU).

3.5 Other Variables: Physician-level Characteristics

We included physician sociodemographic and training characteristics, such as sex, language of practice, country of medical school and the year of CPSO registration. In Objective 1, we included practice locations classified according to Statistics Canada's definitions of rurality. In Objective 2, we included the type of training defined as either the standard two-year Family Medicine program or extended training programs (i.e., emergency medicine, family practice anesthesia, obstetrics and enhanced skills).

3.6 Outcomes

Objective 1: Extended Family Medicine Training

We defined extended Family Medicine training as a binary outcome (yes/no). Extended Family Medicine training was considered for any family physicians who pursued an additional postgraduate year in Family Medicine (i.e., postgraduate year 3 [PGY-3]) beyond the standard two-year program (i.e., postgraduate year 2 in Family Medicine [PGY-2]). We categorized extended family medicine training into four groups: emergency medicine (Category 1), family practice anesthesia (Category 1), obstetrics (Category 2) and enhanced skills programs (all other extended training programs). Due to small cell sizes, enhanced skills programs encompass all other Category 1 programs (i.e., care of the elderly, clinician scholar, palliative care, obstetrical surgical skills, addiction medicine, enhanced surgical skills and sports and exercise medicine) and Category 2 enhanced skills programs (e.g., hospital medicine and women's health). Preliminary exploratory analyses revealed that the average time between completion of Family Medicine residency and the start of extended training was approximately 1.3 years. Among graduates who pursued extended training, 96.9% enrolled within two years of completing their Family Medicine residency. The median time to enrollment was one year, with the 75th percentile at one year and the 90th percentile at two years. Thus, we included all family physicians enrolled in a PGY-3 program within two years of completing their PGY-2.

Objective 2: Practice in Rural or Remote Areas

We classified family physicians' primary practice locations into four categories based on the Statistical Area Classification type (SACtype): large urban (SACtype 1), small urban (SACtypes 2 and 3), semi-rural (SACtypes 4 and 5) and rural and remote (SACtypes 6 and 7). Following the Canadian Institute for Health Information's (CIHI) rurality classification system, we modelled rural or remote practice as a binary outcome: yes, for physicians located in semi-rural or rural/remote areas (SACtypes 4–7) and no, for those in large or small urban areas (SACtypes 1–3) (107,108). Appendix C presents Statistics Canada's Statistical Area Classification type used to categorize practice location.

3.7 Missing Data

We anticipated low missing physician data in this study, as registration with the College of Physicians and Surgeons of Ontario (CPSO) is a legal and professional obligation for all practicing physicians and residents in Ontario. During the assessment of the geographic

distribution of 7,387 family physicians (1995-2021) by primary practice location, initial classification using PCCF+ indicated that 10.3% (n = 758) of physicians' postal codes had an undetermined Statistical Area Classification type (SACtype 9). To address this, we used ArcGIS Online, a cloud-based Geographic Information System (GIS) platform that allows users to analyze maps and geographic data (109). ArcGIS Online was used to overlay physicians' primary practice postal codes onto the 2021 Census boundary file to assign a geographic classification. For validation purposes, postal codes with known SACtype classifications from PCCF+ were cross-checked using ArcGIS, demonstrating a strong alignment between the two classification methods.

3.8 Statistical Analyses

3.8.1 Descriptive Analyses

We used descriptive statistics (i.e., frequencies and proportions) to present the categorical variables in this study. To explore preliminary associations between physicians' characteristics and the outcomes, we employed bivariate statistical tests (i.e., Chi-squared tests) to assess group differences. To understand differences among medical schools, we conducted pairwise comparisons using least squares means with Bonferroni adjustments. The Bonferroni correction is a multiple comparison adjustment method that controls the family-wise error rate, defined as the probability of making at least one Type I error across a set of statistical tests (110,111). This is achieved by dividing the overall significance level (α) by the number of comparisons being conducted. Although effective in reducing the likelihood of false positives, the Bonferroni method is considered a conservative approach. It may increase the risk of Type II errors, thereby decreasing statistical power and widening confidence intervals (112).

3.8.2 Multivariable Analyses

We conducted univariable and multivariable logistic regression models to assess associations between physician-related characteristics and the two binary outcomes (extended training and rural/remote practice). Initially, univariate models were fitted for each predictor, followed by a multivariate model to assess the adjusted effects of all predictors. An exploratory analysis of the correlation matrix revealed high correlation coefficients between UG and PG medical schools, indicating collinearity between primary exposures. Due to the strong correlation between the primary exposures, we developed two separate multivariable models to minimize multicollinearity and ensure stable, interpretable estimates. All variables were included in the

multivariable models regardless of their significance in the univariate analysis, in accordance with Harrell's recommendations to minimize bias from variable selection (113–115).

The availability of self-reported sex data in the CPSO dataset enabled Sex- and Gender-Based Analyses (SGBA+), facilitating the exploration of sex-related differences (116). To examine potential effect modifications, we tested interaction terms between all sociodemographic and training characteristics in the multivariate models. Significant interactions ($p < 0.05$) were retained in the final model based on a likelihood ratio test comparing models with and without the interaction term. Notably, in Objective 1, we found a significant interaction between sex and both UG and PG medical schools, demonstrating that the association between medical schools and the outcomes varied by sex. Consequently, we conducted sex-stratified analyses to examine these associations in greater detail. We presented results from fully adjusted models as odds ratios (ORs) with corresponding 95% confidence intervals (CIs) and p-values to assess statistical significance. All statistical analyses were performed using SAS 9.4M7 (SAS Institute Inc., Cary, NC, USA) via SAS OnDemand, with a two-sided Type I error rate of 0.05.

3.8.3 Sensitivity Analysis

We conducted sensitivity analyses to assess how changes to the inclusion criteria would affect the robustness and generalizability of the primary findings. For Objective 1, we restricted the outcome to emergency medicine trainees to evaluate whether the observed associations held within this specific subgroup. We selected emergency medicine for the sensitivity analysis as it is the most common and longest-running accredited extended training program. For Objective 2, we limited the rural/remote outcome definition to SACtypes 6 and 7 only, representing the most rural practice settings, to test the stability of results under a more conservative rural classification.

3.9 Ethics Approval

We were granted ethical approval by the Ottawa Health Science Network Research Ethics Board (Protocol ID: 20230194-01H) and Bruyère Health Research Ethics Board (M16-25-019).

Chapter 4: Results

4.1 Flow Diagram

This section presents flow diagrams illustrating the inclusion and exclusion criteria applied to define the final study populations for both objectives. The complete manuscripts are provided in Chapters 5 and 6. The final cohort for Objective 1 included 7387 family physicians, while the cohort for Objective 2 comprised 2263 family physicians.

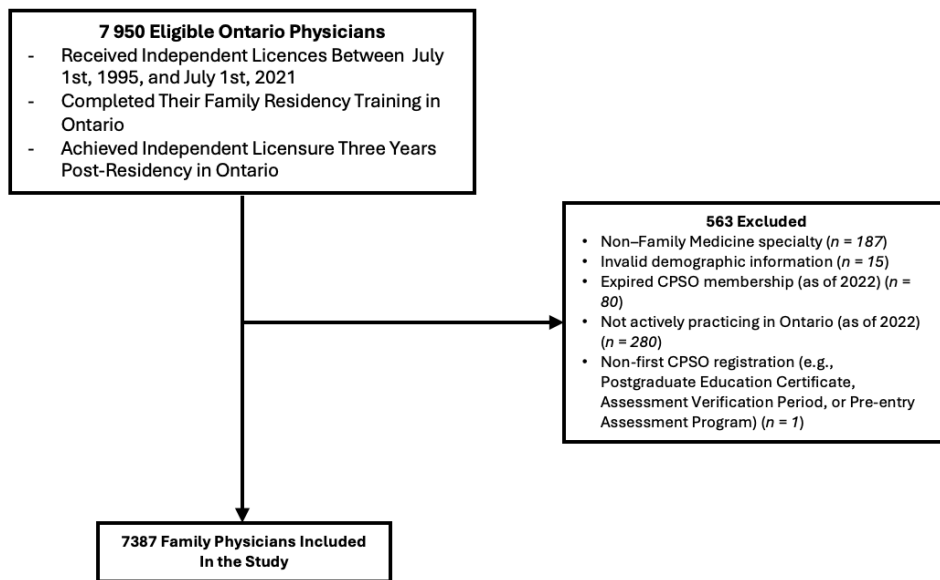


Figure 3. Flow diagram of the study population for Objective 1: Extended Family Medicine Training (n=7387).

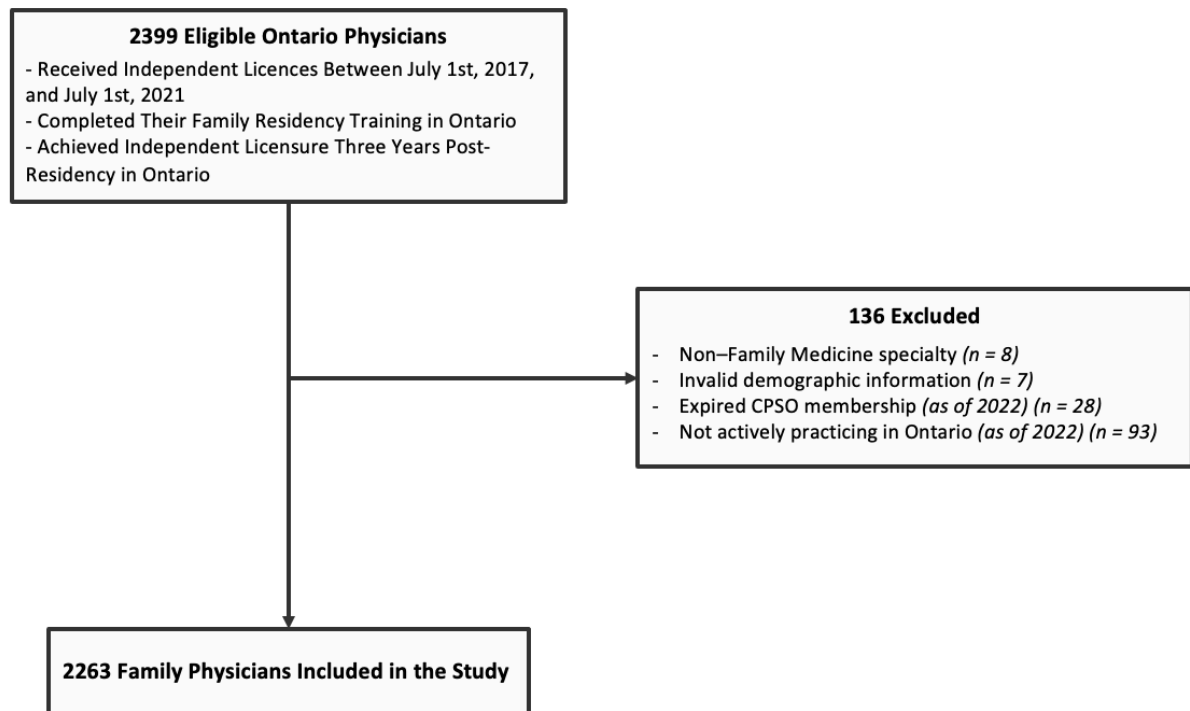


Figure 4. Flow diagram of the study population for Objective 2: Rural and Remote Practice ($n=2263$).

Chapter 5: Predictors of Extended Family Medicine Training

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Competing interests

No other competing interests were declared.

Contributors

SMB, SP, MG, DM, SH and CK were involved in the conceptualization and design of the study. SMB was responsible for analyzing and interpreting the data, as well as drafting the manuscript. All co-authors critically revised the manuscript for intellectual content. CK agreed to act as the guarantor, responsible for ensuring the integrity and accuracy of the data analysis.

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Disclaimer

The analyses, interpretations and conclusions presented in this study are those of the authors alone and do not necessarily reflect the views of the data providers or funding organizations. No endorsement by these entities is intended or should be inferred.

Preface

This chapter presents the study titled “Trends in Extended Family Medicine Training Across Ontario Medical Schools: A Population-Based Cross-Sectional Study, 1995–2021” prepared for submission to the *Canadian Family Physicians (CFP)*. It addresses the first objective of the thesis, which examines how Ontario medical schools contribute to the primary care workforce in terms of graduating family physicians who pursue extended training. We obtained ethics approval from the Ottawa Health Science Network Research Ethics Board (Protocol ID: 20230194-01H) and Bruyère Health Research Ethics Board (M16-25-019). This study is reported using the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies, with the completed checklist provided in Appendix D.

Abstract

Objective: To examine trends in extended family medicine training across Ontario medical schools from 1995 to 2021.

Design: Cross-sectional, physician cohort study.

Setting: Ontario, Canada.

Participants: Ontario family medicine graduates ($n = 7387$) who registered for independent practice with the College of Physicians and Surgeons of Ontario (CPSO) between July 1st, 1995 and July 1st, 2021 and were actively practicing in the province in 2022.

Main Outcome Measures: Number and proportion of Ontario family medicine graduates who pursued extended training year (postgraduate year 3 in Family Medicine [PGY-3]) between 1995 and 2021. We used multivariable logistic regression models to assess the association between family medicine graduates' characteristics and the pursuit of extended training.

Results: Of the 7387 Ontario family medicine graduates, n=1866 (25.3%) pursued extended training. Over the study period, the proportion pursuing extended training ranged from 16.2% in 1995–1997 to 27.4% in 2019–2021. Queen's University consistently had the highest proportion of graduates pursuing extended training programs across all exit cohorts (ranging from 28.1% to 59.4%). The Northern Ontario School of Medicine University (NOSMU) had the lowest proportion of extended training, with 18.3% of graduates completing the program. Canadian medical graduates were more likely to pursue extended training than international graduates (27.8% vs. 14.9%). In the sex-stratified adjusted logistic regression models, Queen's graduates had significantly higher odds of pursuing extended training compared to NOSMU, with odds ratios of 2.03 (95% CI: 1.31–3.16) for males and 5.32 (95% CI: 3.48–8.14) for females.

Conclusion: Over the past two decades, the proportion of family medicine graduates pursuing extended training has increased, with notable variation across Ontario medical schools. As these differences are not accounted for by graduates' characteristics alone, educational context and institutional priorities may play a central role. These findings may inform the development of socially accountable medical education policies that align extended training with population health needs and equitable workforce planning.

Introduction

Canada is experiencing a critical shortage of comprehensive family physicians, a key contributor to the growing primary care crisis. More than 20% of Canadians do not have a regular family physician and many more report difficulties accessing timely care (1,2). Comprehensive primary care refers to a broad range of essential services, such as periodic health assessments, well-baby care and individual psychotherapy, delivered longitudinally to a defined patient population (3). In Ontario, the proportion of family physicians providing this model of care declined from 77%

in 2008 to 65% in 2022 (4), raising concerns about access, continuity and capacity in the primary care system.

In Canada, family medicine is a two-year residency program accredited by the College of Family Physicians of Canada (CFPC). In response to evolving population health needs, the CFPC has implemented educational reforms, such as CanMEDS-FM and the Triple C Competency-Based Curriculum, to reinforce the importance of delivering continuous, community-adapted and comprehensive care (74–77). At the same time, the CFPC has expanded the scope of extended family medicine training in areas such as family practice anesthesia and sports and exercise medicine. These programs were developed to equip family physicians to meet complex and evolving healthcare needs, particularly in rural, remote and underserved regions (79). Together, these reforms reflect the CFPC’s efforts to balance specialized training opportunities with its long-standing commitment to comprehensive, community-based care. In tandem with these reforms, medical schools have seen a steady increase in family medicine residents pursuing extended training programs over the past two decades. According to the Canadian Post-M.D. Education Registry (CAPER), the number of filled positions rose from 172 in 2005/2006 to 400 in 2024/2025, illustrating the scale of this shift (10–12).

A 2016 study identified considerable variation among Canadian medical schools in the proportion of graduates pursuing extended training between 1995 and 2013 (13). These differences may reflect institutional culture, pedagogical approaches, provincial funding structures and social accountability mandates. Although institutional factors help explain some variation in pursuit, concerns have been raised about the increase in extended training placements given ongoing uncertainty about how such training relates to the documented shift toward focused practice among family physicians (14–27). Focused practice refers to a practice pattern in which family physicians provide a substantial portion of their services within a specific domain (e.g., emergency or addiction medicine), rather than delivering a broad range of comprehensive primary care (28–30). In Ontario, the percentage of family physicians practicing in focused care rose from 7.7% in 1993/1994 to 19.2% in 2021/2022 (31). Often framed as a response to evolving population needs, the expansion of extended training calls into question the

long-term supply of comprehensive family physicians and the extent to which this training aligns with medical schools' social accountability mandates (32,33).

Given the increase in extended training placements, there is a need to reassess how the pursuit of extended training varies across Ontario medical schools and how other factors, such as training and sociodemographic characteristics, influence these decisions. To address this gap, we used population-level data to examine trends in extended family medicine training across Ontario's medical schools from 1995 to 2021.

Methods

Study Design, Setting and Population

We conducted a cross-sectional cohort study using data from the College of Physicians and Surgeons of Ontario (CPSO) extracted on June 30th, 2022. We identified Ontario family medicine graduates actively practicing in the province in 2022 and registered for independent practice between July 1st, 1995 and July 1st, 2021. Graduates were excluded if they did not obtain an independent license within three years of completing residency and were not actively practicing in Ontario.

Data Sources

The CPSO data contains mandatory registration information, including demographic characteristics, training profiles and practice details (see **Appendix A**). We determined graduates' reported practice locations by linking their six-character postal codes to Canadian census geographic areas using Postal Code Conversion File Plus (PCCF+) (34). We used Statistics Canada's 2021 Statistical Area Classification types (SACtypes) to categorize rurality. For practice locations that could not be classified by PCCF+, we used the 2021 Census Boundary File in ArcGIS to ensure accurate rurality classification (35).

Outcome

Our outcome of interest was the pursuit of extended family medicine training, defined as the completion of an additional postgraduate year (PGY3) in family medicine beyond the two-year program. We restricted our outcome to graduates who enrolled in an extended training program

within two years of completing their family medicine residency, based on preliminary analyses showing that the average interval was approximately 1.3 years. The CFPC awards certificates of Added Competence (CACs) to nine Category 1 programs: care of the elderly, palliative care, emergency medicine, family practice anesthesia, clinician scholar, obstetrical surgical skills, addiction medicine, enhanced surgical skills and sports and exercise medicine (36,37). Category 2 programs, also referred to as enhanced skills programs, include all other focused areas not recognized as CACs. We categorized extended family medicine training into four groups: emergency medicine (Category 1), family practice anesthesia (Category 1), obstetrics (Category 2) and enhanced skills, a combined category that encompasses all other Category 1 programs (care of the elderly, palliative care, obstetrical surgical skills, addiction medicine, clinician scholar, enhanced surgical skills and sports and exercise medicine), as well as Category 2 enhanced skills.

Family Medicine Graduates' Characteristics

We examined graduates' sociodemographic, training and practice characteristics, including sex, language of practice, undergraduate and postgraduate medical schools, country of medical school, year of CPSO registration and practice location. We classified practice characteristics using Statistics Canada's definitions of rurality (see **Appendix B**).

Statistical Analysis

We used descriptive statistics to summarize graduates' characteristics, presenting categorical variables as frequencies and percentages. We employed Chi-squared tests to assess unadjusted associations between graduates' characteristics and the pursuit of extended family medicine training. To compare outcomes across each medical school, we performed pairwise comparisons using least squares means with Bonferroni adjustments to control for the multiple comparisons (38).

We conducted two separate multivariable logistic regression models, collapsing all extended training into a binary variable (yes/no). Both models were adjusted for all covariates, including sex, language of practice, country of medical school, year of CPSO registration and practice location. Model 1 included postgraduate (PG) medical school and Model 2 included

undergraduate (UG) medical school. We then tested interactions between sex and UG and PG medical schools and executed sex-stratified analyses when interaction terms were statistically significant ($p < 0.05$). We present adjusted odds ratios (ORs) for each predictor with 95% confidence intervals (CIs). We conducted all analyses using SAS 9.4M7 (SAS Institute Inc., Cary, NC, USA) via SAS OnDemand for Academics. A sensitivity analysis was performed by restricting the outcome to emergency medicine trainees to examine the robustness of our findings.

Ethics Approval

Ethics approval was obtained from the Ottawa Health Science Network Research Ethics Board (Protocol ID: 20230194-01H) and Bruyère Health Research Ethics Board (M16-25-019). This study is reported using the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for cross-sectional studies.

Results

Between 1995 and 2021, 7387 Ontario family medicine graduates registered for independent practice. Of these, 1866 (25.3%) pursued extended training, while 5521 (74.7%) completed the standard two-year program. **Supplementary Figure 1** provides the flow diagram for the study population.

Distribution of Ontario family medicine graduate characteristics by type of training

We observed significant differences across all characteristics between graduates of the two-year family medicine and extended training programs (**Table 1**). Compared to those who completed a two-year family medicine program, graduates who pursued extended training were more likely to be Canadian medical graduates (27.8% vs. 14.9%). Graduates who attended the Northern Ontario School of Medicine University (NOSMU) for undergraduate and postgraduate training had the lowest proportion of graduates pursuing extended training (20.6% and 18.3%, respectively).

Table 1. Distribution of Ontario Family Medicine Graduates Practicing in the Province Who Completed a Standard 2-Year Program vs. Those Who Pursued Extended Training Program.

Characteristics	Total Family Medicine Graduates (n = 7387)*	2-Year Family Medicine Program (n = 5521)	Extended Family Medicine Training Program (n = 1866)
Sociodemographic Characteristics			
Sex, no. (%)			
Male	2878 (39%)	2114 (73.4%)	764 (26.6%)
Female	4509 (61%)	3407 (75.6%)	1102 (24.4%)
Languages of Practice, no. (%)			
Unilingual (English)	5026 (68%)	3656 (72.7%)	1370 (27.3%)
Bilingual (English-French)	864 (11.7%)	625 (72.3%)	239 (27.7%)
Bilingual (Other)	1497 (20.3%)	1240 (82.8%)	257 (17.2%)
Training Profiles			
Postgraduate Medical School, no. (%)			
University of Toronto	2517 (34.1%)	1869 (74.3%)	648 (25.7%)
University of Ottawa	1416 (19.2%)	874 (79.7%)	222 (20.3%)
Queen's University	827 (11.2%)	501 (60.6%)	326 (39.4%)
McMaster University	1415 (19.2%)	1068 (75.5%)	347 (24.5%)
Western University	1150 (15.6%)	897 (78%)	253 (22%)
Northern Ontario School of Medicine University	382 (5.2%)	312 (81.7%)	70 (18.3%)
Country of Medical School, no. (%)			

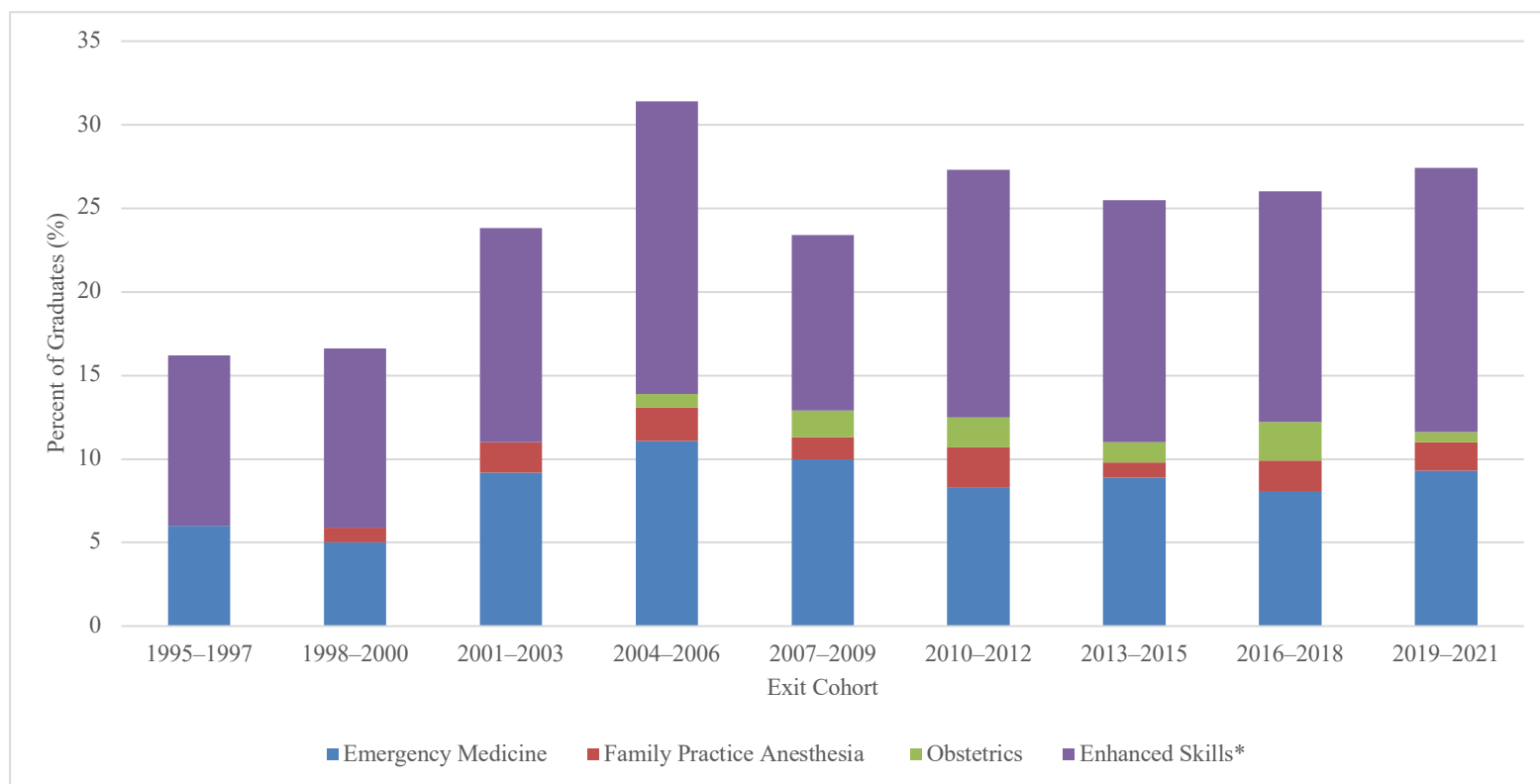
Canadian Medical Graduates	5928 (80.2%)	4280 (72.2%)	1648 (27.8%)
International Medical Graduates	1459 (19.8%)	1241 (85.1%)	218 (14.9%)
Undergraduate Medical School, no. (%)			
University of Toronto	1378 (23.2%)	1000 (72.6%)	378 (27.4%)
University of Ottawa	883 (14.9%)	652 (73.8%)	231 (26.2%)
Queen's University	490 (8.3%)	332 (67.8%)	158 (32.2%)
McMaster University	1164 (19.6%)	829 (71.2%)	335 (28.8%)
Western University	946 (16%)	670 (70.8%)	276 (29.2%)
Northern Ontario School of Medicine University	262 (4.4%)	208 (79.4%)	54 (20.6%)
Other Canadian Medical Schools	805 (13.6%)	589 (73.2%)	216 (26.8%)
Year of CPSO Registration, no. (%)			
Pre-2000	1033 (14%)	853 (82.6%)	180 (17.4%)
2000-2004	836 (11.3%)	590 (70.6%)	246 (29.4%)
2005-2009	1472 (19.9%)	1090 (74.1%)	382 (25.9%)
2010-2014	1965 (26.6%)	1455 (74.1%)	510 (25.9%)
2015-2019	2081 (28.2%)	1533 (73.7%)	548 (26.3%)
Practice Characteristics			

Practice Location, no. (%)			
Large Urban	6046 (81.8%)	4547 (75.2%)	1499 (24.8%)
Small Urban	685 (9.3%)	482 (70.4%)	203 (29.6%)
Semi-Rural	447 (6.1%)	343 (76.7%)	104 (23.3%)
Rural/Remote	209 (2.8%)	149 (71.3%)	60 (28.7%)

* The 'Total Family Medicine Graduates' column presents the percent of the full sample. All other columns present the percent of each characteristic subgroup (i.e., row percentages).

Trends in extended family medicine training

Combined enhanced skills represented the most common type of extended training, followed by emergency medicine, family practice anesthesia and obstetrics (**Figure 1**). Overall, the proportion of graduates pursuing extended training increased between 1995 and 2006 (16.2% to 31.4%) but remained relatively stable from 2007 to 2021 (23.4% to 27.4%).

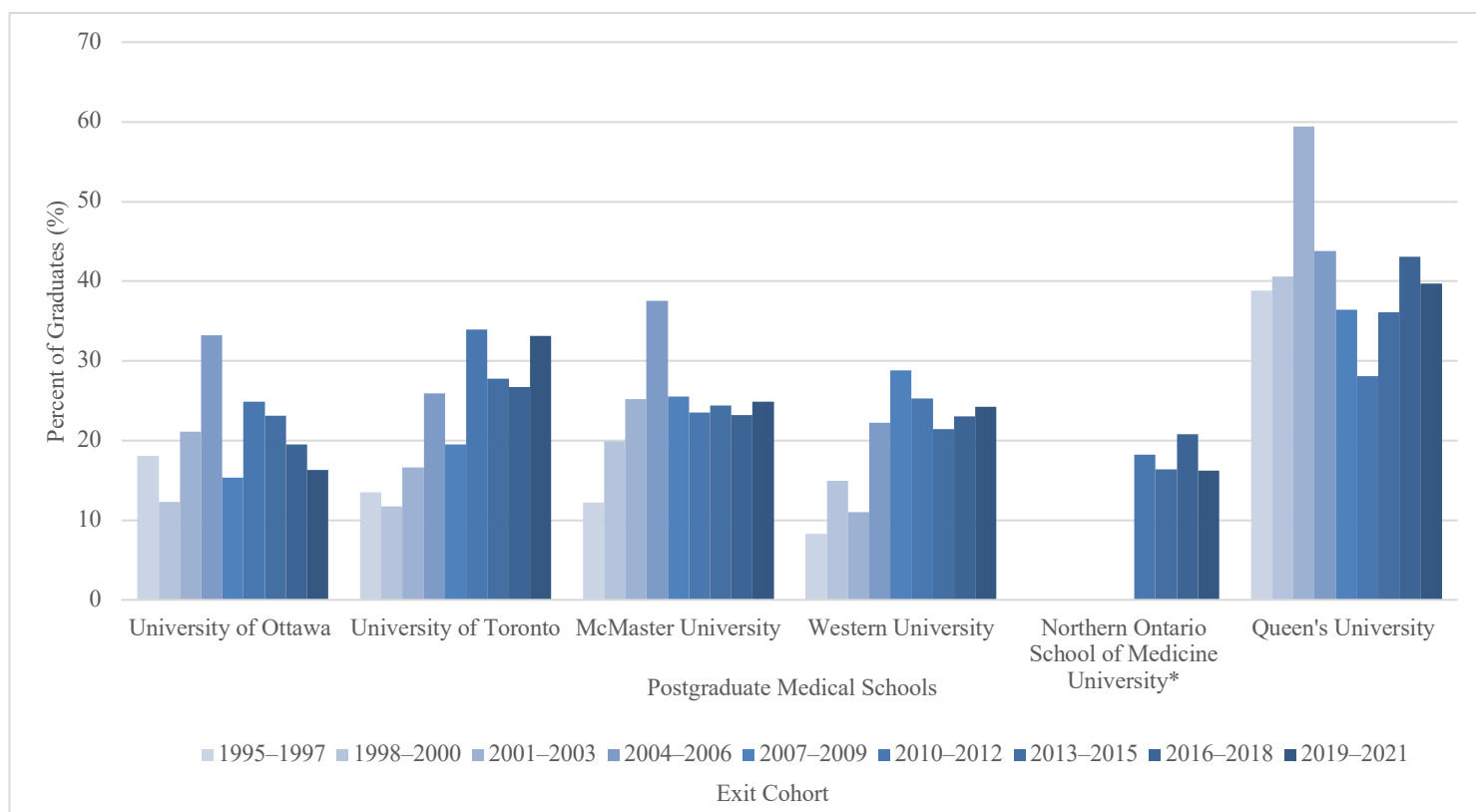


*Enhanced Skills Category includes all other Category 1 and 2 programs.

Figure 1. Percentage of Graduates Across Extended Family Medicine Training Programs in Ontario.

Extended training by postgraduate medical school

While the proportion of family medicine graduates pursuing extended training varied across institutions and over time, at the postgraduate level, Queen's University consistently had the highest proportions of graduates pursuing extended training, ranging from 28.1% to 59.4% (**Figure 2**). In the sex-stratified analysis, Queen's University had the largest proportion of graduates pursuing emergency medicine in both sexes (17.5% of males and 10.2% of females, respectively) (**Supplementary Table 1**).



*The beginning of the study period for NOSMU is from 2010 to 2012.

Figure 2. Sex-Standardized Annual Percentage of Graduates Who Pursued Extended Training by Postgraduate Medical School.

In the sex-stratified models, among males only, graduates from Queen’s University had significantly higher odds of pursuing extended training compared to NOSMU graduates (OR = 2.03; 95% CI: 1.31–3.16) (**Table 2**). Among female graduates, all other Ontario medical schools showed higher odds than NOSMU, with the strongest effect observed among Queen’s University graduates (OR = 5.32; 95% CI: 3.48-8.14). Comparable results were found in the undergraduate medical school model (**Supplementary Table 2**). The sensitivity analysis limited to Emergency Medicine trainees indicates that this program type is not the main factor driving differences observed across medical schools (**Supplementary Table 4**).

Table 2. Sex-Stratified Predictors of Extended Training Among Ontario Family Medicine Graduates Practicing in the Province–Postgraduate Medical School Model.

Variables		Adjusted ORs* (95% CI)	
		Male	Female
Postgraduate Medical School	University of Toronto	1.05 (0.69–1.59)	3.08 (2.06–4.62)
	University of Ottawa	0.97 (0.62–1.52)	1.65 (1.07–2.53)
	Queen's University	2.03 (1.31–3.16)	5.32 (3.48-8.14)
	McMaster University	0.98 (0.64–1.51)	2.60 (1.72–3.94)
	Western University	0.91 (0.59–1.40)	2.72 (1.77–4.20)
	Northern Ontario School of Medicine University	Ref	Ref
Country of Medical School	Canadian Medical Graduates	1.97 (1.53–2.54)	2.05 (1.64–2.58)
	International Medical Graduates	Ref	Ref
Languages of Practice	Unilingual (English)	1.03 (0.77–1.38)	0.74 (0.60–0.93)
	Bilingual (Other)	0.84 (0.58–1.20)	0.47 (0.35–0.62)
	Bilingual (English-French)	Ref	Ref
Year of CPSO Registration	2015-2019	1.67 (1.26-2.22)	2.04 (1.57-2.65)
	2010-2014	1.82 (1.36-2.44)	1.99 (1.53-2.59)
	2005-2009	2.24 (1.65-3.06)	1.95 (1.49-2.57)

	2000-2004	2.67 (1.90-3.76)	2.00 (1.49-2.70)
	Pre-2000	Ref	Ref
Practice Location	Large Urban	1.02 (0.63-1.63)	0.72 (0.46-1.11)
	Small Urban	1.42 (0.85-2.37)	0.83 (0.51-1.36)
	Semi-Rural	1.04 (0.59-1.84)	0.52 (0.31-0.88)
	Rural/Remote	Ref	Ref

*OR=odds ratio; 95% CI=95% confidence intervals

Figure 3 presents adjusted pairwise comparisons of postgraduate medical schools using least squares means estimates with Bonferroni adjustments. Graduates from Queen's University had the highest odds of pursuing extended training, significantly exceeding those from the University of Ottawa, University of Toronto and Western University (95% CIs shown in **Supplementary Table 3**).

McMaster University	1.00	1.71*	0.49**	1.32	0.88	1.02
NOSMU		1.00	0.29**	0.77	0.51**	0.60*
Queen's University			1.00	2.72**	1.80**	2.09**
University of Ottawa				1.00	0.66*	0.77
University of Toronto					1.00	1.16
Western University						1.00
	McMaster University	NOSMU	Queen's University	University of Ottawa	University of Toronto	Western University

**p-value* < 0.05

***p-value* < 0.0001

^d *Adjusted for sex, country of medical school, languages of practice, year of CPSO registration and practice location.*

Figure 3. Pairwise Comparisons of Ontario Postgraduate Medical Schools: Odds Ratio Estimates (Least Squares Means) for the Likelihood of Producing Family Medicine Graduates Pursuing Extended Training.

Discussion

In this study, a quarter of Ontario family medicine graduates pursued extended family medicine training between 1995 and 2021. The proportion of Ontario family medicine graduates pursuing extended training increased as the number of extended training positions in Canada grew between 1995 and 2006; however, it remained relatively stable after 2007 (39). We noted considerable variation by postgraduate and undergraduate medical school of training, with Queen’s University consistently having the highest proportion of graduates pursuing extended training in both sexes. Notably, in our study, extended training was not associated with a higher likelihood of rural or remote practice. We also found that Canadian medical graduates had significantly higher odds of pursuing extended training compared to international medical graduates.

We observed significant variation across Ontario medical schools in the proportion of graduates pursuing extended training, consistent with a prior study by Ross et al., which reported that Queen’s University had the highest proportion of family medicine residents pursuing extended training among Canadian medical schools between 1995 and 2013 (13). These differences may reflect variations in institutional culture, which includes both formal efforts to implement socially accountable education and more subtle influences such as the informal curriculum. The informal curriculum refers to implicit messages, social culture and norms that may devalue comprehensive family medicine and shape residents’ decisions to pursue extended training (40–42). Prior research has shown that medical schools, through their training sites, curricula and educational priorities, influence graduates’ career choices and practice patterns (43–47). For instance, the Northern Ontario School of Medicine University had the lowest proportion of graduates pursuing extended training, likely due to its strong social accountability mandate, characterized by early and sustained rural placements, community-engaged learning, distributed

training in underserved settings and a curriculum focused on comprehensive primary care aligned with the needs of northern and rural populations (19,48–53). In contrast, studies have shown that the informal curriculum, particularly in urban-based medical schools, may promote extended training as more prestigious or necessary, influencing learners’ perceptions and choices (33,41,42,54–56). A qualitative study of Ontario family medicine residents found that many viewed extended training as essential, a belief shaped by implicit messages about the limitations of two-year family medicine programs (57). Future research should explore how differences in institutional culture, both explicit and implicit, interact to influence decisions regarding extended training.

Consistent with previous literature demonstrating that over 20% of family medicine graduates pursue extended training, our findings suggest that the growth in extended training has not been primarily driven by rural workforce needs (13,58,59). Similarly, a 2009 retrospective cohort study found no significant differences in practice locations among graduates of emergency medicine, care of the elderly, palliative care and other Category 2 programs (60). Extended training programs were developed as part of the CFPC’s broader efforts to address physician shortages and evolving healthcare needs, particularly in underserved populations (79). However, in 2022, the CFPC reported that extended training graduates predominantly practiced in urban settings between 2004 and 2014, with little change in distribution over time (61). Evidence suggests that among extended training programs, only family practice anesthesia and Category 2 programs were associated with increased rates of rural practice (60). In addition, previous research has shown that many CCFP(EM) graduates ultimately establish their practices in urban settings, suggesting a possible mismatch between the intended goals of extended training programs and actual workforce distribution (62,63). In addition to geographic distribution, evidence indicates that graduates who completed extended training were more likely to work in non-office or hospital-based settings, particularly in the domain of their training (60). Our findings emphasize the need to critically evaluate the alignment between the design and implementation of extended training programs and their contribution to equitable physician distribution.

Finally, our study found that Canadian medical graduates were more likely to pursue extended training than IMGs, consistent with similar findings in the literature (13–27,58,59). Research has shown that IMGs are more likely to be older than CMGs, which may influence their decision-making towards the pursuit of extended training (64,65). At the same time, Return-of-Service (ROS) agreements may impose constraints that limit residents' ability to pursue extended family medicine training (66–68). Relatedly, studies have shown that IMGs are less likely to remain in rural or remote communities' long term, which may reduce their interest in programs that are often positioned as supporting rural health needs (69–71). Nevertheless, the underlying factors driving the differential pursuit of extended training between CMGs and IMGs remain poorly understood and warrant further investigation. Given that an increasing proportion of family medicine residency positions are being filled by IMGs, understanding these patterns is essential for anticipating future workforce composition and distribution.

Limitations

We were able to include all CPSO registered Ontario family medicine graduates between 1995 and 2021 in our study. However, we could only study factors influencing the decision to pursue extended family medicine training that were captured in the CPSO database. As a result, we were unable to account for key determinants of practice, such as age, rural or urban upbringing, policy drivers, socioeconomic background, or exposure to rural medical education, factors shown to influence practice patterns in previous research. In addition, we lacked data on the number of applicants and the positions available per medical school over the study period, restricting our ability to determine whether the observed differences in participation were solely due to physician choices or restricted access to extended training opportunities. Although our study spanned over two decades, we could not assess changes in individual practice patterns over time (e.g., transitions from comprehensive to focused practice). Finally, as our study was restricted to graduates who completed both residency and independent licensure in Ontario, the findings may not be generalizable to other provinces or to graduates who left Ontario to train or practice elsewhere.

Conclusion

Between 1995 and 2021, one in four Ontario family medicine graduates pursued extended training, with significant variation across medical schools. This variation was not fully explained by graduate-level characteristics such as sex, language of practice, or country of medical school, suggesting that institutional culture, including formal and informal educational influences, may have played a crucial part in shaping these decisions. We found that extended training was not associated with rural or remote practice and Canadian medical graduates were significantly more likely than international medical graduates to pursue these opportunities. In a healthcare system with declining access to comprehensive primary care, medical schools must examine how extended training influences practice patterns and contributes to, or diverges from, social accountability goals. These insights should inform education policies, medical environment and training structures that are responsive to population health needs and equity-oriented workforce planning.

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Appendices

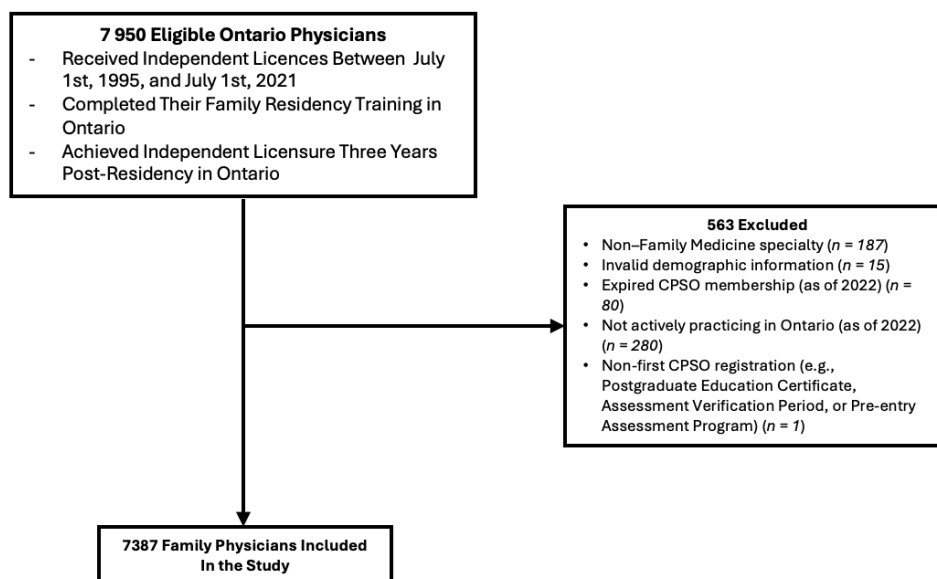
Appendix A: Variable Descriptions from CPSO Dataset

Variables	Description
cpso_num	CPSO registry number
gender	Self identified sex
first_name	First name
last_name	Last name
former_names	Physician's previous name
date_of_death	Death date of physician
address	Address of physician's primary practice location
postal_code	Postal code of physician's primary practice location
pt	Province of physician's primary practice location
mem_status	CPSO member status
mem_status_eff_date	Effective date of CPSO member status
member_expiry_date	Expiry date of CPSO membership
reg_class	CPSO registration class
reg_class_eff_date	Effective date of registration class
language_0 to language_10	Languages spoken (multiple variables)
med_school	Medical school graduated from
med_school_country	Country of medical school
edu_grad_year	Year graduated from medical school
specialty_0 to specialty_8	Specialties listed
specialty_issued_date_0 to _8	Date specialty was issued
reghistory_action_0 to _41	Registration history actions
reghistory_issued_date_0 to _41	Registration history issued dates
postgrad_date_start_0 to _27	Postgraduate training start dates
postgrad_date_end_0 to _10	Postgraduate training end dates

Appendix B: Statistics Canada - Statistical Area Classification Type (SACtype)

SACtype	Description
1	Census subdivision within census metropolitan area
2	Census subdivision within census agglomeration with at least one census tract
3	Census subdivision within census agglomeration having no census tracts
4	Census subdivision outside of census metropolitan area and census agglomeration having strong metropolitan influence
5	Census subdivision outside of census metropolitan area and census agglomeration having moderate metropolitan influence
6	Census subdivision outside of census metropolitan area and census agglomeration having weak metropolitan influence
7	Census subdivision outside of census metropolitan area and census agglomeration having no metropolitan influence

Supplement



Supplementary Figure 1. Flow diagram of the study population.

Supplementary Table 1. Sex-Stratified Percentage of Graduates Who Pursued Extended Training by Postgraduate Medical School and Country of Medical School, 1995-2021.

	Male					Female				
	2-Year Family Medicine Program (No., %)	Emergency Medicine (No., %)	Family Practice Anesthesia (No., %)	Obstetrics (No., %)	Enhanced Skills*(No., %)	2-Year Family Medicine Program (No., %)	Emergency Medicine (No., %)	Family Practice Anesthesia (No., %)	Obstetrics (No., %)	Enhanced Skills*(No., %)
Postgraduate Medical School										
University of Toronto (N = 2517)	697 (75.4%)	116 (12.5%)	10 (1.1%)	3 (0.3%)	99 (10.7%)	1172 (73.6%)	104 (6.5%)	4 (0.3%)	48 (3%)	264 (16.6%)
University of Ottawa (N = 1096)	301 (75.1%)	40 (10%)	18 (4.5%)	0 (0%)	42 (10.5%)	573 (82.4%)	39 (5.6%)	2 (0.3%)	2 (0.3%)	79 (11.4%)
Queen's University (N = 827)	198 (58.7%)	59 (17.5%)	10 (3%)	0 (0%)	70 (20.8%)	303 (61.8%)	50 (10.2%)	7 (1.4%)	2 (0.4%)	128 (26.1%)
McMaster University (N = 1415)	405 (74.7%)	54 (10%)	18 (3.3%)	3 (0.6%)	62 (11.4%)	663 (75.9%)	39 (4.5%)	15 (1.7%)	14 (1.6%)	142 (16.3%)
Western University (N = 1150)	408 (77%)	66 (12.5%)	14 (2.6%)	1 (0.2%)	41 (7.7%)	489 (78.9%)	41 (6.6%)	6 (1%)	12 (1.9%)	72 (11.6%)
Northern Ontario School of Medicine University (N = 382)	105 (73.4%)	20 (14%)	6 (4.2%)	0 (0%)	12 (8.4%)	207 (86.6%)	11 (4.6%)	4 (1.7%)	1 (0.4%)	16 (6.7%)
Country of Medical School										
Canadian Medical Graduates (N = 5928)	1660 (71.2%)	322 (13.8%)	70 (3%)	7 (0.3%)	272 (11.7%)	2620 (72.8%)	267 (7.4%)	35 (1%)	67 (1.9%)	608 (16.9%)
International Medical Graduates (N = 1459)	454 (83%)	33 (6%)	6 (1.1%)	0 (0%)	54 (9.9%)	787 (86.3%)	17 (1.9%)	3 (0.3%)	12 (1.3%)	93 (10.2%)

*Enhanced Skills Category includes all other Category 1 and 2 programs.

Supplementary Table 2. Sex-Stratified Predictors of Extended Training Among Ontario Family Medicine Graduates Practicing in the Province (1995–2021) – Undergraduate Medical School Model

Variables		Adjusted ORs* (95% CI)	
		Male	Female
Undergraduate Medical School	University of Toronto	1.03 (0.62–1.72)	2.61 (1.67–4.07)
	University of Ottawa	0.98 (0.58–1.67)	2.03 (1.29–3.18)
	Queen's University	1.33 (0.77–2.31)	2.89 (1.77–4.72)
	McMaster University	1.01 (0.60–1.71)	2.57 (1.66–4.00)
	Western University	1.01 (0.60–1.68)	2.74 (1.73–4.33)
	Other Canadian Medical Schools	0.83 (0.48–1.42)	2.45 (1.56–3.86)

	International Medical Schools	0.51 (0.30–0.87)	1.19 (0.75–1.89)
	Northern Ontario School of Medicine University	Ref	Ref
Languages of Practice	Unilingual (English)	1.00 (0.75–1.35)	0.81 (0.66–1.01)
	Bilingual (Other)	0.79 (0.55–1.12)	0.53 (0.40–0.71)
	Bilingual (English-French)	Ref	Ref
Year of CPSO Registration	2015-2019	1.71 (1.28–2.27)	2.07 (1.59–2.68)
	2010-2014	1.85 (1.38–2.48)	2.03 (1.56–2.63)
	2005-2009	2.25 (1.66–3.07)	1.89 (1.44–2.48)
	2000-2004	2.64 (1.88–3.71)	2.03 (1.51–2.73)
	Pre-2000	Ref	Ref
Practice Location	Large Urban	0.99 (0.62–1.58)	0.70 (0.46–1.07)
	Small Urban	1.42 (0.85–2.36)	0.74 (0.46–1.19)
	Semi-Rural	1.10 (0.63–1.93)	0.52 (0.31–0.86)
	Rural/Remote	Ref	Ref

*OR=odds ratio; 95% CI=95% confidence intervals

Supplementary Table 3. Odds Ratio and 95% Confidence Intervals of the Pairwise Comparisons of Ontario Postgraduate Medical Schools: Odds Ratio Estimates (Least Squares Means) for the Likelihood of Producing Family Medicine Graduates Pursuing Extended Training.

Variables	Adjusted ORs* (95% CI)
McMaster University vs NOSMU	1.71 (1.10–2.66)
McMaster University vs Queen’s University	0.49 (0.37–0.65)
McMaster University vs University of Ottawa	1.32 (0.98–1.79)
McMaster University vs University of Toronto	0.88 (0.70–1.10)
McMaster University vs Western University	1.02 (0.77–1.35)
NOSMU vs Queen’s University	0.29 (0.18–0.45)

NOSMU vs University of Ottawa	0.77 (0.49–1.23)
NOSMU vs University of Toronto	0.51 (0.33–0.79)
NOSMU vs Western University	0.60 (0.38–0.94)
Queen’s University vs University of Ottawa	2.72 (1.98–3.73)
Queen’s University vs University of Toronto	1.80 (1.39–2.33)
Queen’s University vs Western University	2.09 (1.55–2.83)
University of Ottawa vs University of Toronto	0.66 (0.50–0.87)
University of Ottawa vs Western University	0.77 (0.56–1.06)
University of Toronto vs Western University	1.16 (0.90–1.50)

*OR=odds ratio; 95% CI=95% confidence intervals.

Supplementary Table 4. Sensitivity Analysis – Sex-Stratified Predictors of Emergency Training Among Ontario Family Medicine Graduates Practicing in the Province (Postgraduate Medical School Model).

Variables		Adjusted ORs* (95% CI)	
		Male	Female
Postgraduate Medical School	University of Toronto	0.76 (0.45–1.29)	1.53 (0.80–2.93)
	University of Ottawa	0.61 (0.34–1.10)	1.19 (0.60–2.37)
	Queen's University	1.18 (0.67–2.07)	2.64 (1.34–5.18)
	McMaster University	0.57 (0.33–1.01)	0.99 (0.50–1.98)
	Western University	0.82 (0.47–1.42)	1.99 (1.00–3.97)
	Northern Ontario School of Medicine University	Ref	Ref
Country of Medical School	Canadian Medical Graduates	2.79 (1.90–4.09)	3.85 (2.28–6.50)
	International Medical Graduates	Ref	Ref
Languages of Practice	Unilingual (English)	0.86 (0.59–1.25)	0.78 (0.55–1.12)
	Bilingual (Other)	0.78 (0.49–1.24)	0.50 (0.30–0.83)
	Bilingual (English-French)	Ref	Ref

Year of CPSO Registration	2015-2019	1.69 (1.14–2.52)	1.92 (1.19–3.12)
	2010-2014	2.19 (1.47–3.26)	1.58 (0.97–2.58)
	2005-2009	2.23 (1.46–3.41)	2.29 (1.40–3.74)
	2000-2004	2.06 (1.29–3.31)	2.98 (1.79–4.97)
	Pre-2000	Ref	Ref
Practice Location	Large Urban	6.99 (1.97–24.86)	5.69 (1.13–28.69)
	Small Urban	5.87 (1.60–21.52)	7.83 (1.50–40.80)
	Semi-Rural	2.93 (0.73–11.74)	3.66 (0.67–20.04)
	Rural/Remote	Ref	Ref

**OR=odds ratio; 95% CI=95% confidence intervals.*

Chapter 6: Predictors of Practice in Rural or Remote Areas

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Competing interests

No other competing interests were declared.

Contributors

SMB, SP, MG, DM, SH and CK were involved in the conceptualization and design of the study. SMB was responsible for analyzing and interpreting the data, as well as drafting the manuscript. All co-authors critically revised the manuscript for intellectual content. CK agreed to act as the guarantor, responsible for ensuring the integrity and accuracy of the data analysis.

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Disclaimer

The analyses, interpretations and conclusions presented in this study are those of the authors alone and do not necessarily reflect the views of the data providers or funding organizations. No endorsement by these entities is intended or should be inferred.

Preface

The previous chapter presented a cross-sectional cohort study examining trends in extended family medicine training among graduates of Ontario medical schools. Our findings highlight that the pursuit of extended training, a factor associated with focused practice, varies across institutions. While this first study explored the training composition of Ontario's primary care workforce, concerns remain regarding the distribution of family physicians across the province.

This chapter presents the study, "Predictors of Practice in Rural or Remote Areas Among Family Medicine Graduates: A Population-Based Cross-Sectional Study in Ontario", prepared for submission to the *Canadian Medical Association Journal (CMAJ)*. It addresses the second objective of the thesis, which aims to determine the extent to which Ontario's medical schools contribute to a socially accountable family medicine workforce by examining the practice location of their graduates. We obtained ethics approval from the Ottawa Health Science Network Research Ethics Board (Protocol ID: 20230194-01H) and Bruyère Health Research Ethics Board (M16-25-019). This study is reported using the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies, with the completed checklist provided in Appendix E.

Abstract

Background

Access to comprehensive primary care is declining across Ontario, particularly in rural and northern communities. This study examined the representation of Ontario medical schools in the rural primary care workforce and predictors of practice in rural or remote areas.

Methods

We conducted a cross-sectional cohort study using data from the College of Physicians and Surgeons of Ontario (CPSO) website. We included all family medicine graduates who obtained an independent license between 2017 and 2021. Our primary outcome was having a rural or remote practice location in 2022. We used multivariable logistic regression models to assess the association between medical graduates' characteristics and practice in rural or remote areas.

Results

We included 2263 family medicine graduates, of whom 235 (10.4%) had a primary practice in a rural or remote community within their first five years of practice. The proportion of graduates practicing in rural settings ranged from 25.9% for NOSMU, 15.7% for the University of Ottawa, 15.2% for Queen's University, 12.6% for Western University, 7.5% for McMaster University, to 4.1% for the University of Toronto. Graduates with extended training in emergency medicine were significantly less likely to practice in rural or remote areas compared to those who completed the standard two-year family medicine program (3.1% vs. 11.1%). The proportion of rural practice was similar between CMGs and IMGs (10.3% vs. 10.7%, respectively). In the adjusted pairwise comparisons of postgraduate medical schools, McMaster University had significantly lower odds of practicing in rural or remote settings compared to graduates from NOSMU (OR = 0.23, 95% CI: 0.11–0.49), Queen's University (OR = 0.44, 95% CI: 0.21–0.92) and the University of Ottawa (OR = 0.46, 95% CI: 0.22–0.96). University of Toronto graduates also had significantly lower odds compared to those from Western University (OR = 0.30, 95% CI: 0.14–0.61).

Interpretation

Medical schools in Ontario are not equally contributing to the supply of comprehensive care physicians in rural settings. These differences are not explained by graduate-level characteristics such as sex, language of practice, or country of medical school, suggesting other admission factors or school factors, including culture and curriculum, may be contributing to these variations. International medical graduates and those with emergency medicine training were not more likely to practice in rural or remote areas. Our findings highlight potential areas for policy intervention to improve the supply of rural family physicians.

Introduction

A well-functioning health care system requires a strong primary care foundation (1,2). However, access to primary care in Canada has been declining for several years, contributing to a growing strain on the broader health system, with 20% of the population, or an estimated 6.5 million Canadians, without a family doctor (3–6). The decline disproportionately affects underserved populations, intensifying existing health inequities (7). For example, nearly 18% of Ontarians live in rural or remote areas, yet only 9.3% of family physicians serve these populations (8,9). Furthermore, rural and northern communities in Ontario face compounded challenges, including language barriers and limited access to culturally appropriate care, further exacerbating access barriers within the primary care system (10–12).

Medical schools play a central role in shaping the physician workforce and are, therefore, critical to addressing the ongoing shortage of family physicians in rural or remote areas (13–15). In Canada, social accountability mandates require medical schools to align their activities with the priority health needs of the communities they serve (16–20), prompting many institutions to implement targeted initiatives, such as rural training sites and mandatory rural rotations in family medicine residency programs (21–23). For instance, the University of Toronto's Department of Family and Community offers a Rural and Northern Initiative, with community-based training in sites such as Midland, Orillia, Alliston, Port Perry and Uxbridge (24–26).

Previous studies have identified several predictors of rural practice, including rural background, age, parental education, marital status, as well as training in rural sites (27–36). Targeted

provincial policies and the type of family medicine training may also influence rural workforce outcomes. An evaluation by the College of Family Physicians of Canada (CFPC) found that more than 65% of physicians with extended family medicine training (Postgraduate Year-3 [PGY-3]) practiced in large urban areas annually between 2004 and 2014 (37). Ontario's Return-of-Service (ROS) agreements for international medical graduates (IMGs) aim to address the geographic maldistribution; yet evidence suggests that IMGs are less likely to remain in underserved areas long term (38,39). Despite these interventions, the extent to which Ontario's medical schools have contributed to the rural workforce in recent years remains unclear.

To address this gap, we examined predictors of practice in rural or remote areas among Ontario family medicine graduates. Specifically, this study aimed to assess the extent to which medical schools contributed to the rural physician workforce.

Methods

Study Design, Setting and Population

We conducted a cross-sectional cohort study using data from the College of Physicians and Surgeons of Ontario (CPSO) extracted on June 30th, 2022. We identified Ontario family medicine graduates actively practicing in the province in 2022 and registered for independent practice with the CPSO between July 1st, 2017 and July 1st, 2021. Graduates were excluded if they did not obtain an independent license within three years of completing residency and were not actively practicing in Ontario.

Data Sources

The CPSO data contains mandatory registration information, including demographic characteristics, training profiles and practice details (see Appendix A). We determined graduates' reported practice locations by linking their six-character postal codes to Canadian census geographic areas using Postal Code Conversion File Plus (PCCF+) (40). We used Statistics Canada's 2021 Statistical Area Classification types (SACtypes) to categorize rurality. For practice locations that could not be classified by PCCF+, we used the 2021 Census Boundary File in ArcGIS to ensure accurate rurality classification (41).

Outcome

Graduates' practice locations were grouped into four categories based on SACtype: large urban (SACtype 1), small urban (SACtypes 2 and 3), semi-rural (SACtypes 4 and 5) and rural/remote (SACtypes 6 and 7) (see **Appendix B**). In multivariable modelling, our primary outcome was defined as having a primary practice location in either a semi-rural or rural/remote community (SACtypes 4-7) within the first five years of practice.

Variables: Family Medicine Graduates' Characteristics

We examined graduates' sociodemographic and training characteristics, including sex, language of practice, undergraduate and postgraduate medical schools, country of medical school, year of CPSO registration and type of training. We defined extended family medicine training as the completion of an additional postgraduate year (PGY-3) in family medicine beyond the standard two-year program. According to the College of Family Physicians of Canada (CFPC), Category 1 programs leading to Certificates of Added Competence (CACs) encompass care of the elderly, palliative care, emergency medicine, family practice anesthesia, clinician scholar, obstetrical surgical skills, addiction medicine, enhanced surgical skills and sports and exercise medicine. Category 2 programs include all enhanced skills areas not recognized as CACs. We categorized extended family medicine training into four groups: emergency medicine, family practice anesthesia, obstetrics and enhanced skills (all other Category 1 and 2 programs). In addition, we restricted our analyses to graduates who enrolled in an extended training program within two years of completing their family medicine residency, based on preliminary analyses showing that the average interval was approximately 1.3 years.

Statistical Analysis

We used descriptive statistics to summarize graduates' characteristics, presenting categorical variables as frequencies and percentages. We employed Chi-squared tests to assess unadjusted associations between graduates' characteristics and practice in underserved areas. To compare outcomes across each medical school, we performed pairwise comparisons using least squares means with Bonferroni adjustments to control for multiple comparisons. While conservative, the Bonferroni correction controls the family-wise error rate, resulting in wider confidence intervals and reduced statistical power (42).

We conducted two separate multivariable logistic regression models, collapsing practice in underserved areas into a binary variable (rural/remote (SACtype 4-7) vs. urban (SACtype 1-3)). Both models were adjusted for all covariates, including sex, language of practice, country of medical school, year of CPSO registration and type of training. Model 1 included postgraduate (PG) medical school and Model 2 included undergraduate (UG) medical school.

We tested interactions between sex and UG medical school and sex and PG medical schools and performed sex-stratified analyses when interaction terms were statistically significant ($p < 0.05$). We present adjusted odds ratios (ORs) for each predictor with 95% confidence intervals (CIs). We conducted all analyses using SAS 9.4M7 (SAS Institute Inc., Cary, NC, USA) via SAS OnDemand for Academics. A sensitivity analysis was performed by restricting the outcome to SACtypes 6-7 (rural/remote practices) to examine the robustness of our findings.

Ethics Approval

Ethics approval was obtained from the Ottawa Health Science Network Research Ethics Board (Protocol ID: 20230194-01H) and Bruyère Health Research Ethics Board (M16-25-019). This study is reported using the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for cross-sectional studies.

Results

Our cohort included 2263 Ontario family medicine graduates who were identified as registering with the CPSO for independent practice between 2017 and 2021. Of these, 235 (10.4%) were practicing in rural or remote areas in 2022, including 147 (6.5%) in semi-rural and 88 (3.9%) in rural/remote communities. **Supplementary Figure 1** provides the flow diagram for the study population. Practice in large urban areas was consistent across CPSO registration years. Compared to those practicing in urban settings, a greater proportion of graduates practicing in rural or remote communities were male (11.2% vs. 9.7%) and bilingual in French and English (15.6% vs. 10.3% among English-speakers and 7.9% among others) (**Table 1**).

Table 1. Characteristics of Ontario Family Medicine Graduates by Practice Location.

	Total Family Medicine Graduates (n = 2263)**	Large Urban (n = 1810 [80%])	Small Urban (n = 218 [9.6%])	Semi- Rural (n = 147 [6.5%])	Rural/Remote (n = 88 [3.9%])
Sociodemographic Characteristics					
Sex, no. (%)					
Male	942 (41.6%)	726 (77.1%)	110 (11.7%)	66 (7%)	40 (4.2%)
Female	1321 (58.4%)	1084 (82.1%)	108 (8.2%)	81 (6.1%)	48 (3.6%)
Languages of Practice, no. (%)					
Unilingual (English)	1730 (76.4%)	1382 (79.9%)	171 (9.9%)	110 (6.4%)	67 (3.9%)
Bilingual (English-French)	205 (9.1%)	142 (69.3%)	31 (15.1%)	21 (10.2%)	11 (5.4%)
Bilingual (Other)	328 (14.5%)	286 (87.2%)	16 (4.9%)	16 (4.9%)	10 (3%)
Training Profiles					
Postgraduate Medical School, no. (%)					
University of Toronto	755 (33.4%)	686 (90.9%)	38 (5%)	15 (2%)	16 (2.1%)
University of Ottawa	281 (12.4%)	214 (76.2%)	23 (8.2%)	34 (12.1%)	10 (3.6%)
Queen's University	263 (11.6%)	195 (74.1%)	28 (10.7%)	20 (7.6%)	20 (7.6%)
McMaster University	453 (20%)	379 (83.7%)	40 (8.8%)	24 (5.3%)	10 (2.2%)
Western University	349 (15.4%)	259 (74.2%)	46 (13.2%)	41 (11.7%)	3 (0.9%)
Northern Ontario School of Medicine University	162 (7.2%)	77 (47.5%)	43 (26.5%)	13 (8%)	29 (17.9%)
Undergraduate Medical School, no. (%)					
University of Toronto	370 (20.1%)	332 (89.7%)	22 (6%)	9 (2.4%)	7 (1.9%)
University of Ottawa	274 (14.9%)	214 (78.1%)	22 (8%)	22 (8%)	16 (5.8%)
Queen's University	133 (7.2%)	114 (85.7%)	8 (6%)	6 (4.5%)	5 (3.8%)
McMaster University	376 (20.4%)	307 (81.7%)	35 (9.3%)	25 (6.6%)	9 (2.4%)
Western University	291 (15.8%)	213 (73.2%)	44 (15.1%)	30 (10.3%)	4 (1.4%)

Northern Ontario School of Medicine University	126 (6.8%)	71 (56.4%)	27 (21.4%)	12 (9.5%)	16 (12.7%)
Other Canadian Medical Schools	271 (14.7%)	219 (80.8%)	23 (8.5%)	11 (4.1%)	18 (6.6%)
Country of Medical School, no. (%)					
Canadian Medical Graduates	1841 (81.4%)	1470 (79.9%)	181 (9.8%)	115 (6.2%)	75 (4.1%)
International Medical Graduates	422 (18.6%)	340 (80.6%)	37 (8.8%)	32 (7.6%)	13 (3.1%)
Type of Training, no. (%)					
2-Year Family Medicine Program	1657 (73.2%)	1314 (79.3%)	159 (9.6%)	122 (7.4%)	62 (3.7%)
Emergency Medicine	195 (8.6%)	169 (86.7%)	20 (10.3%)	4 (2.1%)	2 (1%)
Family Practice Anesthesia	41 (1.8%)	13 (31.7%)	13 (31.7%)	9 (22%)	6 (14.6%)
Obstetrics	32 (1.4%)	28 (87.5%)	2 (6.2%)	1 (3.1%)	1 (3.1%)
Enhanced Skills*	338 (14.9%)	286 (84.6%)	24 (7.1%)	11 (3.3%)	17 (5%)
Year of CPSO Registration, no. (%)					
2011-2013	36 (1.6%)	27 (75%)	6 (16.7%)	3 (8.3%)	0 (0%)
2014-2016	1000 (44.2%)	787 (78.7%)	104 (10.4%)	67 (6.7%)	42 (4.2%)
2017-2019	1227 (54.2%)	996 (81.2%)	108 (8.8%)	77 (6.3%)	46 (3.7%)

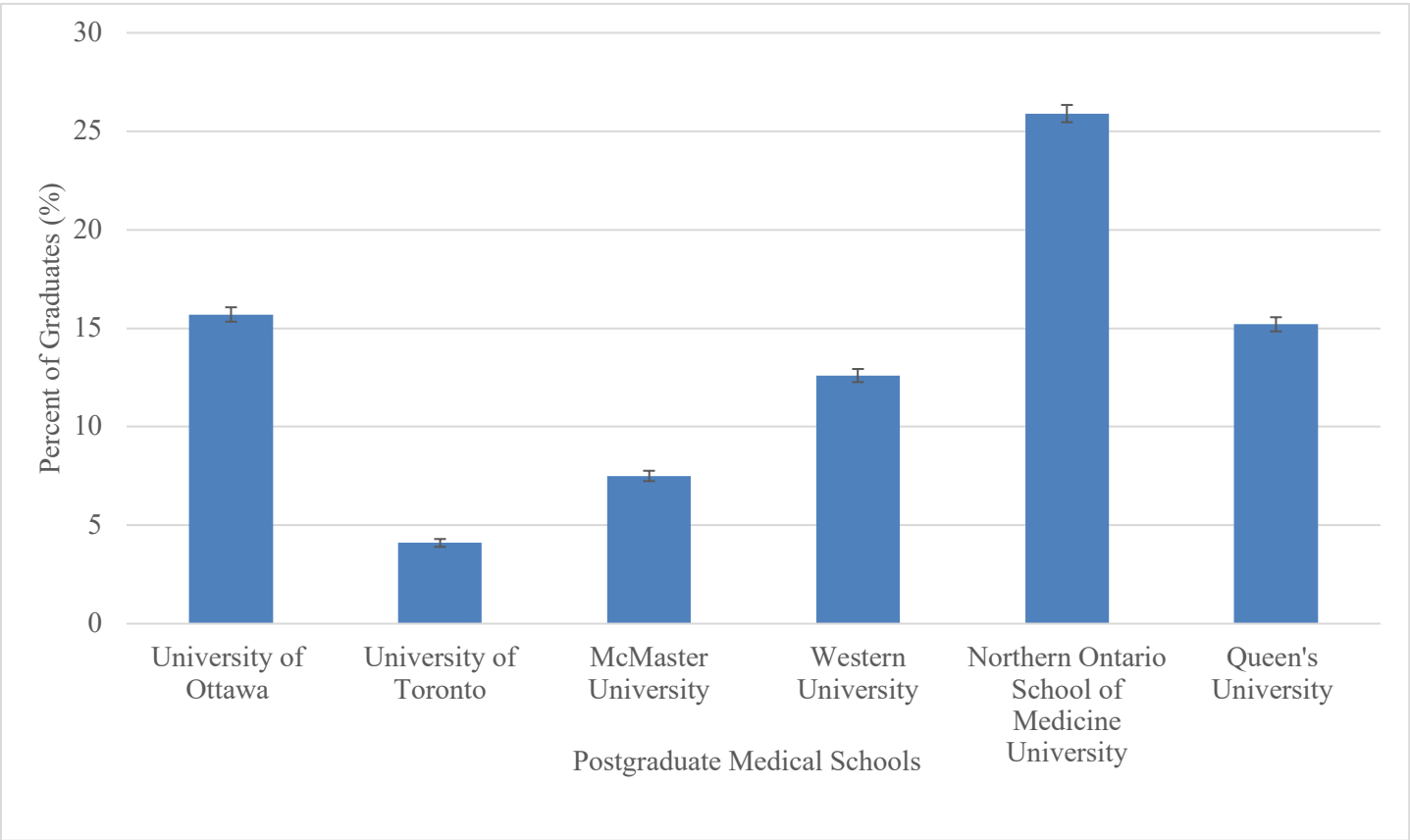
*Enhanced Skills includes all other Category 1 and Category 2.

**The 'Total Family Medicine Graduates' column presents the percent of the full sample. All other columns present the percent of each characteristic subgroup (i.e., row percentages).

Practice in rural or remote areas across postgraduate medical schools

Graduates from the Northern Ontario School of Medicine University (NOSMU) were most likely to be practicing in rural or remote communities (25.9%), followed by those from the University of Ottawa (15.7%), Queen's University (15.2%) and Western University (12.6%). The

University of Toronto and McMaster University had the lowest proportion of practice in rural or remote areas (4.1% and 7.5% respectively) (**Figure 1**).



**Sample sizes (n): University of Ottawa: n = 281, University of Toronto: n = 755, Queen's University: n = 263, McMaster University: n = 453, Western University: n = 349, NOSMU: n = 162.*

*** Error bars represent the standard deviation (SD) of the proportion of graduates practicing in rural or remote areas.*

Figure 1. Percentage of Graduates Practicing in Rural or Remote Areas of Ontario in 2022, by Postgraduate Medical School.

Table 2 presents adjusted odds ratios (ORs) and 95% confidence intervals (CIs) from the multivariable logistic regression model. After adjusting for graduates’ characteristics, no sociodemographic or training factors, aside from medical school of graduation and type of training, were significantly associated with rural or remote practice. Compared to NOSMU graduates, all other Ontario medical schools had lower odds of practicing in underserved areas, with the largest difference observed at the University of Toronto (OR = 0.12; 95% CI: 0.07–0.21). Emergency medicine trainees had lower odds of practicing in rural or remote areas compared to those who completed a standard two-year family medicine program (OR = 0.26;

95% CI: 0.12–0.57). Similar findings were observed in the undergraduate medical school model and in the sensitivity analysis (**Supplementary Table 1**).

Table 2. Predictors for Rural or Remote Practice Among Ontario Family Medicine Graduates – Postgraduate Medical School Model.

Variables		Adjusted ORs* (95% CI)
Postgraduate Medical School	University of Toronto	0.12 (0.07-0.21)
	University of Ottawa	0.50 (0.31-0.80)
	Queen's University	0.52 (0.31-0.85)
	McMaster University	0.23 (0.14-0.38)
	Western University	0.41 (0.25-0.67)
	Northern Ontario School of Medicine University	Ref
Country of Medical School	Canadian Medical Graduates	0.91 (0.63-1.31)
	International Medical Graduates	Ref
Sex	Male	1.23 (0.93-1.63)
	Female	Ref
Languages of Practice	Unilingual (English)	0.90 (0.58-1.40)
	Bilingual (Other)	0.77 (0.42-1.40)
	Bilingual (English-French)	Ref
Type of Training	Emergency Medicine	0.26 (0.12-0.57)
	Enhanced Skills**	1.09 (0.76-1.55)
	2-Year Family Medicine Program	Ref
Year of CPSO Registration	2011-2013	0.86 (0.27-2.74)
	2014-2016	1.10 (0.83-1.45)
	2017-2019	Ref

*OR=odds ratio; 95% CI=95% confidence intervals

**Enhanced Skills includes all other Category 1 and Category 2.

Figure 2 displays an adjusted pairwise comparisons of postgraduate medical schools using least squares means with Bonferroni adjustments. Graduates from NOSMU had significantly greater odds of practicing in rural/remote areas compared with those from the University of Toronto (OR=8.19; 95% CI: 3.77-17.81) and Western University (OR=2.44; 95% CI: 1.16-5.11) (95% CIs shown in **Supplementary Table 2**).

McMaster University	1.00	0.23**	0.44*	0.46*	1.86	0.55
NOSMU		1.00	1.95	2.03	8.19**	2.44*
Queen's University			1.00	1.04	4.21**	1.25
University of Ottawa				1.00	4.05**	1.20
University of Toronto					1.00	0.30**
Western University						1.00
	McMaster University	NOSMU	Queen's University	University of Ottawa	University of Toronto	Western University

* p -value < 0.05

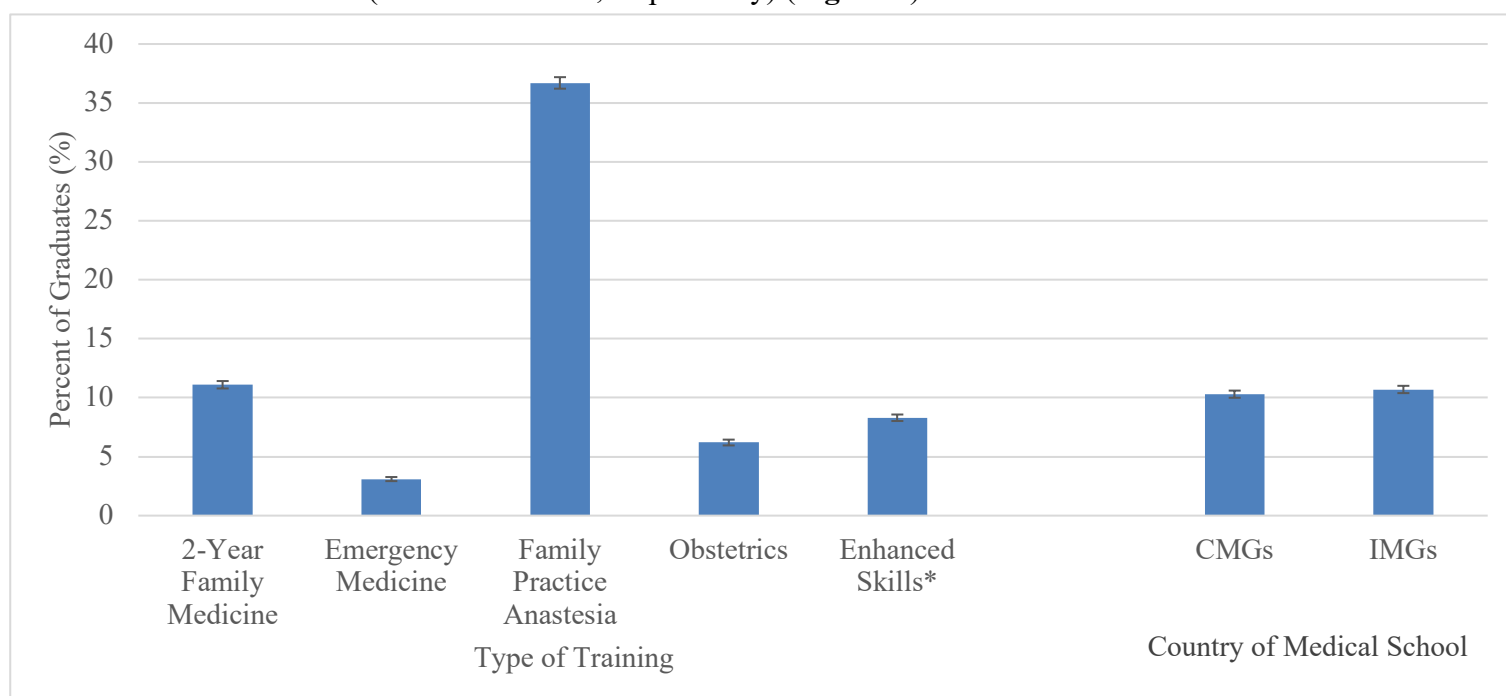
** p -value < 0.0001

^d Adjusted for sex, country of medical school, languages of practice, year of CPSO registration and type of training.

Figure 2. Pairwise Comparisons of Ontario Postgraduate Medical Schools: Odds Ratio Estimates (Least Squares Means) for the Likelihood of Producing Family Medicine Graduates Practicing in Rural or Remote Areas.

Practice in rural or remote areas by type of training and country of medical school

Graduates with extended training in family practice anesthesia were most likely to practice in rural or remote regions (36.6%), followed by those who completed a two-year family medicine (11.1%), enhanced skills (8.3%), obstetrics (6.2%) and emergency medicine programs (3.1%). Canadian and international medical graduates had similar proportions of graduates practicing in underserved areas (10.3% vs. 10.7%, respectively) (**Figure 3**).



* Enhanced Skills includes all other Category 1 and Category 2.

**Sample sizes (n): 2-Year Family Medicine: n = 1657, Emergency Medicine: n = 195, Family Practice Anesthesia: n = 41, Obstetrics: n = 32, Enhanced Skills: n = 338, Canadian Medical Graduates (CMGs): n = 1841, International Medical Graduates (IMGs): n = 422.

*** Error bars represent the standard deviation (SD) of the proportion of graduates practicing in rural or remote areas.

Figure 3: Percentage of Ontario Family Medicine Graduates Practicing in Rural or Remote Areas in 2022, by Type of Training and Country of Medical School.

Interpretation

In this study of 2263 recent Ontario family medicine graduates, we found that 10.4% were practicing in rural or remote regions as of 2022. We observed a strong association between postgraduate medical school and subsequent practice location. Graduates from NOSMU had the highest odds of practicing in rural or remote settings, followed by those from Queen's University, the University of Ottawa and Western University. In contrast, graduates from the

University of Toronto and McMaster University had significantly lower odds of rural or remote practice. Graduates with emergency medicine training were also less likely to practice in rural or remote communities than those who completed the standard two-year family medicine program. We found no meaningful differences in rural or remote practice between CMGs and IMGs.

A range of practices are known to increase the likelihood of family physicians working in rural or remote settings, including rural clinical rotations, distributed training sites and dedicated rural family medicine streams (27,43–47). Our findings suggest that variability in the proportion of graduates practicing in rural/remote settings across Ontario medical schools likely reflects differences in how these practices have been incorporated into their educational structures. These initiatives may, in some cases, align with broader social accountability commitments. The Northern Ontario School of Medicine University reported a higher proportion of family medicine graduates in rural or remote areas, an outcome likely attributed to its strong social accountability mandate, community-engaged distributed education model and admissions policies aligned with the priority health needs of northern and underserved populations (48–54). As part of a shared provincial commitment to train physicians to meet the needs of all Ontarians, the University of Toronto and McMaster University have, since 2006, adopted distributed medical education approaches, establishing satellite campuses and clinical training sites to expand educational exposure in underserved areas (55–57). For instance, McMaster University delivers family medicine training across Niagara, Waterloo and smaller communities, including Simcoe and Owen Sound (24,26,58). Despite these initiatives, the University of Toronto and McMaster University continue to contribute fewer graduates to underserved regions. This gap underscores the need for urban-based medical schools to realign their curricula, training structures and admissions policies to ensure their efforts translate into improved access to care in underserved communities.

Our findings are consistent with prior research showing that emergency medicine training is associated with a higher likelihood of urban practice (59,60). In 2021/2022, emergency medicine was the most common focused practice area among family physicians, accounting for 37% of those with a focused practice designation (61). The CFPC(EM) certification was developed to equip family physicians with additional training in the management of acute illness and injury

across rural and urban emergency departments (62). Although there is limited research on the practice patterns of physicians with this certification, evidence from emergency departments in underserved communities in southwestern Ontario showed that only 7.5% of CCFP(EM)-certified physicians were working in those departments (63). In contrast, other studies have shown that family physicians with extended training in enhanced skills are more likely to practice in underserved areas (59,60). Together, these findings highlight the need to assess how distinct forms of extended training shape practice patterns and contribute to meeting the needs of underserved communities.

Finally, we found that IMGs and CMGs had a comparable proportion of practice in underserved communities. In Ontario, IMGs are required to fulfill Return-of-Service (ROS) agreements mandating practice in the province for five years following postgraduate training. Although this policy is intended to address the geographic maldistribution of family physicians, eligible communities under the ROS agreement include any municipality in Ontario outside of Ottawa and the Greater Toronto Area (39). While previous research has indicated that IMGs are less likely to remain in rural communities over the long term, no studies have evaluated the effectiveness of ROS policies (64–66). Our results show that even in their first five years of independent practice, many IMGs are not practicing in rural or remote areas, suggesting a disconnect between policy intent and workforce outcomes. This raises questions about the implementation and enforcement of ROS agreements, as well as whether current policies sufficiently account for the personal and structural factors that influence physician practice patterns. Further research is needed to examine the factors that shape IMG practice patterns and assess the long-term effectiveness of ROS-based strategies in the Canadian context.

Limitations

The study has several potential limitations. Many factors could influence graduates' decisions to practice in rural or remote communities and the current analysis is limited to variables readily available in the CPSO database (27–36). In particular, we lacked data on important individual- and area-level sociodemographic characteristics, such as rural upbringing, immigration status and other contextual factors (i.e., age and family status) (30,67). These unmeasured factors may influence practice location and limit the interpretation of observed associations. Small cell sizes

required grouping certain types of extended training, which may have obscured differences in practice location between specific specializations. In addition, the use of cross-sectional, population-level data limited our ability to draw causal inferences or assess changes in practice location over time. Although these limitations constrain the scope of our findings, they underscore the need for qualitative and longitudinal research that incorporates richer sociodemographic and training data to better understand physician workforce distribution and inform targeted policy interventions.

Conclusion

We found substantial variation in the contribution of Ontario medical schools to the rural family physician workforce, with some institutions contributing far less than others. Graduates with emergency medicine training were less likely to practice in rural or remote communities and international medical graduates were not overrepresented in underserved areas despite Return-of-Service mandates. Our findings highlight the need for more targeted approaches to medical education and workforce policy to address Canada's growing primary care crisis, particularly in rural regions. To meet population needs, Ontario's medical education system must align admissions, training and accountability frameworks with the goal of equitable access to care.

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Appendices

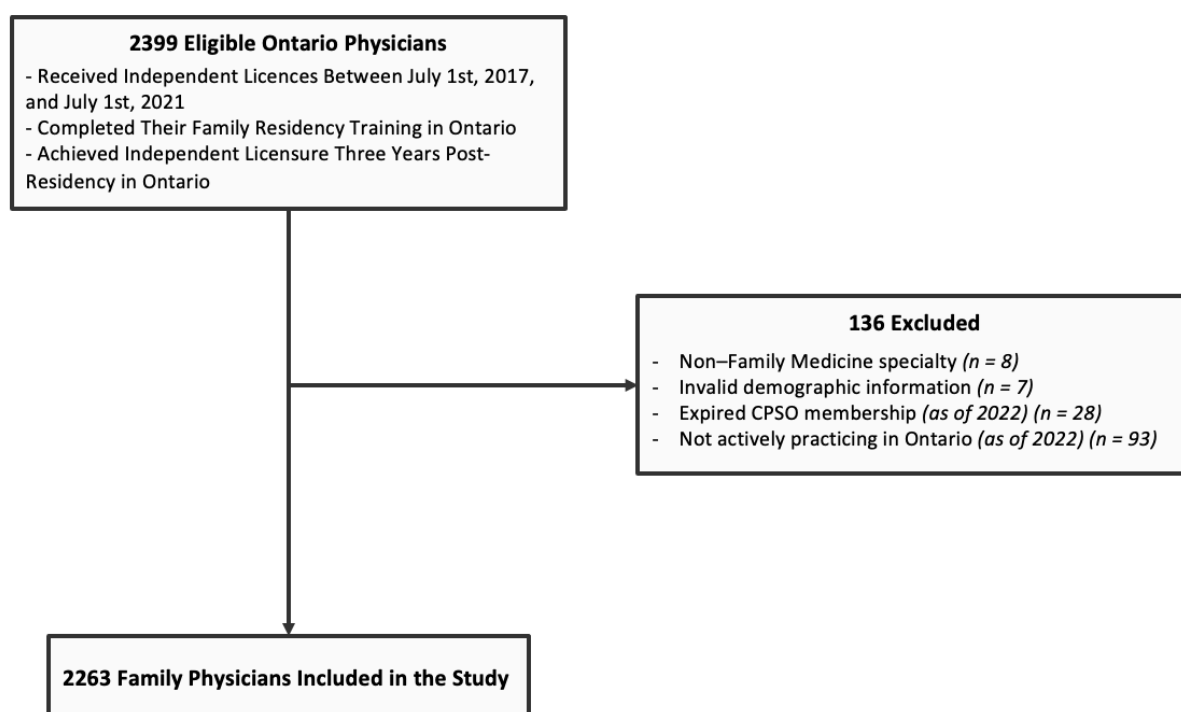
Appendix A: Variable Descriptions from CPSO Dataset

Variables	Description
cpso_num	CPSO registry number
gender	Self identified sex
first_name	First name
last_name	Last name
former_names	Physician's previous name
date_of_death	Death date of physician
address	Address of physician's primary practice location
postal_code	Postal code of physician's primary practice location
pt	Province of physician's primary practice location
mem_status	CPSO member status
mem_status_eff_date	Effective date of CPSO member status
member_expiry_date	Expiry date of CPSO membership
reg_class	CPSO registration class
reg_class_eff_date	Effective date of registration class
language_0 to language_10	Languages spoken (multiple variables)
med_school	Medical school graduated from
med_school_country	Country of medical school
edu_grad_year	Year graduated from medical school
specialty_0 to specialty_8	Specialties listed
specialty_issued_date_0 to _8	Date specialty was issued
reghistory_action_0 to _41	Registration history actions
reghistory_issued_date_0 to _41	Registration history issued dates
postgrad_date_start_0 to _27	Postgraduate training start dates
postgrad_date_end_0 to _10	Postgraduate training end dates

Appendix B: Statistics Canada - Statistical Area Classification Type (SACtype)

SACtype	Description
1	Census subdivision within census metropolitan area
2	Census subdivision within census agglomeration with at least one census tract
3	Census subdivision within census agglomeration having no census tracts
4	Census subdivision outside of census metropolitan area and census agglomeration having strong metropolitan influence
5	Census subdivision outside of census metropolitan area and census agglomeration having moderate metropolitan influence
6	Census subdivision outside of census metropolitan area and census agglomeration having weak metropolitan influence
7	Census subdivision outside of census metropolitan area and census agglomeration having no metropolitan influence

Supplement



Supplementary Figure 1. Flow diagram of the study population.

Supplementary Table 1. Predictors for Rural or Remote Practice Among Ontario Family Medicine Graduates– Undergraduate Medical School Model.

Variables		Adjusted ORs* (95% CI)
Undergraduate Medical School	University of Toronto	0.17 (0.09–0.32)
	University of Ottawa	0.56 (0.32–0.96)
	Queen's University	0.33 (0.15–0.69)
	McMaster University	0.35 (0.20–0.62)
	Western University	0.46 (0.26–0.81)
	Other Canadian Medical Schools	0.41 (0.23–0.72)
	International Medical Schools	0.43 (0.25–0.74)
	Northern Ontario School of Medicine University	Ref
Sex	Male	1.39 (0.91–2.14)
	Female	Ref
Languages of Practice	Unilingual (English)	0.80 (0.52–1.25)
	Bilingual (Other)	0.64 (0.35–1.14)
	Bilingual (English-French)	Ref
Type of Training	Emergency Medicine	0.25 (0.11–0.56)
	Enhanced Skills**	1.05 (0.74–1.49)
	2-Year Family Medicine Program	Ref
Year of CPSO Registration	2011-2013	0.89 (0.28–2.78)
	2014-2016	1.09 (0.83–1.44)
	2017-2019	Ref

*OR=odds ratio; 95% CI=95% confidence intervals

**Enhanced Skills includes all other Category 1 and Category 2.

Supplementary Table 2. Odds Ratio and 95% Confidence Intervals of the Pairwise Comparisons of Ontario Postgraduate Medical Schools: Odds Ratio Estimates (Least Squares Means) for the Likelihood of Producing Family Medicine Graduates Practicing in Rural or Remote Areas.

Variables	Adjusted ORs* (95% CI)
McMaster University vs NOSMU	0.23 (0.11–0.49)
McMaster University vs Queen’s University	0.44 (0.21–0.92)
McMaster University vs University of Ottawa	0.46 (0.22–0.96)
McMaster University vs University of Toronto	1.86 (0.88–3.96)
McMaster University vs Western University	0.55 (0.27–1.13)
NOSMU vs Queen’s University	1.95 (0.92–4.14)
NOSMU vs University of Ottawa	2.03 (0.98–4.19)
NOSMU vs University of Toronto	8.19 (3.77–17.81)
NOSMU vs Western University	2.44 (1.16–5.11)
Queen’s University vs University of Ottawa	1.04 (0.50–2.15)
Queen’s University vs University of Toronto	4.21 (2.00–8.86)
Queen’s University vs Western University	1.25 (0.62–2.54)
University of Ottawa vs University of Toronto	4.05 (1.91–8.57)
University of Ottawa vs Western University	1.20 (0.59–2.44)
University of Toronto vs Western University	0.30 (0.14–0.61)

*OR=odds ratio; 95% CI=95% confidence intervals.

Supplementary Table 3. Sensitivity Analysis – Predictors for Rural/Remote (SACtype 6-7) Practice Among Ontario Family Medicine Graduates (Postgraduate Medical School Model).

Variables		Adjusted ORs* (95% CI)
Postgraduate Medical School	University of Toronto	0.09 (0.05-0.17)
	University of Ottawa	0.16 (0.08-0.34)
	Queen's University	0.32 (0.17-0.60)
	McMaster University	0.10 (0.05-0.20)

	Western University	0.04 (0.01-0.13)
	Northern Ontario School of Medicine University	Ref
Country of Medical School	Canadian Medical Graduates	0.94 (0.51-1.73)
	International Medical Graduates	Ref
Sex	Male	1.37 (0.88-2.11)
	Female	Ref
Languages of Practice	Unilingual (English)	1.15 (0.58-2.28)
	Bilingual (Other)	1.28 (0.51-3.21)
	Bilingual (English-French)	Ref
Type of Training	Emergency Medicine	0.29 (0.08-1.02)
	Enhanced Skills**	1.79 (1.08-2.96)
	2-Year Family Medicine Program	Ref
Year of CPSO Registration	2011-2013	0.36 (0.02-6.32)
	2014-2016	1.11 (0.72-1.71)
	2017-2019	Ref

*OR=odds ratio; 95% CI=95% confidence intervals

**Enhanced Skills includes all other Category 1 and Category 2.

Chapter 7: Discussion

7.1 Overview of the Thesis

Ontario's primary care system is currently facing a significant crisis, with over 2.5 million residents without a family physician (211). The crisis is fueled by the declining number of new medical graduates choosing family medicine and the shift away from comprehensive practice among family physicians (212,213). This change is particularly concerning, given the increasing demand for comprehensive care, especially in underserved areas where physician shortages are most acute. This thesis examines how Ontario medical schools contribute to the primary care workforce by analyzing whether their family medicine graduates pursue extended training programs and provide care in rural or remote communities.

We conducted two cross-sectional cohort studies, drawing on data extracted from the College of Physicians and Surgeons of Ontario, linked to PCCF+. This dataset contains detailed information, including training, sociodemographic and practice-related characteristics, for all Ontario residents and fully licensed physicians. While the sample size and timeframes varied by objective, our primary cohort consisted of graduates of Ontario family medicine residency programs who had obtained independent licenses and were actively practicing in the province. We employed multivariable logistic regression models to examine the associations between graduate-level characteristics and the pursuit of extended training and practice in rural or remote areas.

The two studies were conceptualized to investigate distinct yet interrelated dimensions of the primary care workforce outcomes in Ontario. The first study examines trends in extended family medicine training, highlighting how medical education environments influence physicians' decisions to pursue additional competencies. The study found that 25.3% of family medicine graduates pursued extended training from 1995 to 2021, with Queen's University consistently having the highest proportion of graduates pursuing such training across nearly all exit cohorts. After adjustment, we found that Queen's University graduates had significantly higher odds of pursuing extended training compared to NOSMU graduates (males: OR = 2.03; 95% CI: 1.31–3.16; females: OR = 5.32; 95% CI: 3.48–8.14). In contrast, the second study examines the geographic distribution of Ontario's family medicine graduates, emphasizing how the social accountability mandates of certain institutions better position them to address rural or remote shortages. In 2022, only 10.4% of graduates practiced in rural or remote areas. After adjustment, the University of

Toronto (OR = 0.12; 95% CI: 0.07-0.21) and McMaster University (OR = 0.23; 95% CI: 0.14-0.38) had the lowest odds of their graduates practicing in rural or remote areas compared to NOSMU.

The subsequent sections integrate findings from both studies to provide recommendations for reforming medical education and health workforce planning, aiming to achieve long-term sustainability of the primary care system in Ontario during a critical period of reform. The remainder of this chapter interprets the findings, outlines educational implications, offers additional recommendations, discusses strengths and limitations and proposes directions for future research.

7.2 Interpretation of Findings

A project-specific model (Figure 1) was developed to illustrate how medical schools serve as a crucial entity that influences the composition and distribution of the primary care workforce. While this model is grounded in social accountability principles, it also recognizes that variation in graduate outcomes cannot be attributed solely to medical schools, as individual motivations and policy contexts may also shape career decisions and practice patterns. The following subsections interpret the results through the lens of SA while acknowledging these wider contextual factors.

7.2.1 Medical Schools and Training Stakeholders: Social Accountability Mandates and Influence on Workforce Outcomes

Ontario's medical schools operate under social accountability mandates, which emphasize their responsibility to train physicians who are responsive to the health needs of the populations they serve. To fulfill this mandate, institutions have implemented various efforts, including revising admissions processes, updating curricula, modifying institutional culture, tailoring research priorities and structuring training pathways in response to community-identified health needs and provincial workforce priorities. Given the current primary care crisis, a key indicator of whether medical schools are meeting this mandate is their ability to graduate family physicians who provide comprehensive care and choose to practice in underserved communities (179).

Many Ontario medical schools have undertaken initiatives to modify admissions policies, adapt formal curricular structures and expand exposure to community-based clinical training. For instance, Queen's University introduced new pathways for applicants from low socioeconomic backgrounds and adjusted its Indigenous student pathway. Western University delivers family medicine training through multiple rural teaching sites, including Goderich and Hanover, while the University of Ottawa maintains a Francophone stream and rural placements in communities such as

Winchester and Hawkesbury (214,215). Institutional culture, including informal curriculum, has been shown to play a role in influencing trainees' values, professional identity and long-term practice patterns. Several studies suggest that implicit messaging, conveyed through informal interactions with faculty and peer discourse, may prioritize specialization while casting family medicine and rural practice as a less prestigious or temporary option (216–220). Although this thesis does not directly assess these mechanisms, the observable variation across medical schools in the pursuit of extended family medicine training and practice in rural or remote areas may reflect differences in how social accountability principles are interpreted and embedded within educational environments.

Among Ontario's medical schools, the Northern Ontario School of Medicine University has a widely recognized and intentionally embedded commitment to social accountability. Its institutional model is grounded in the active recruitment of students from underserved regions and in community-engaged education across nearly 90 Northern Ontario communities (58,221–226). The family medicine program embeds training directly within these communities, tailoring clinical rotations to regional health priorities and reinforcing rural generalist care as a viable and valued career pathway (227–229). NOSMU was the first Canadian medical school to use the *Institutional Self-Assessment of Social Accountability Tool* in its undergraduate medical education program (230). This tool enabled faculty members to critically assess how well their activities and training align with the social accountability mandates, identify gaps and suggest necessary improvements. NOSMU's approach, explicitly framed around the health needs of the populations it serves, illustrates how social accountability principles can be integrated into a school's mission, educational structure and training placements. This serves as a reflective reference point for other medical schools, rather than a prescriptive standard.

7.2.2 System-level Policies

Variation in outcomes may also be influenced by broader policy environments that influence where physicians practice and how career choices are sustained over time. The Root-Stem Model (RSM) conceptualizes rural workforce retention as dependent on interconnected elements such as academic education, recruitment, job training, remuneration, workforce environment and investment in skills and resources (231). Although these elements cannot be directly measured within the CPSO data, they may lead to differences in practice location depending on how effectively system-level supports are experienced by early-career physicians. Government policies,

such as the ROS agreements, are intended to address immediate physician shortages through temporary distribution. In Ontario, IMGs are mandated to fulfill ROS obligations, which order them to practice in designated underserved areas for a fixed period following their residency. However, our findings suggest that ROS policies may not even achieve this short-term objective, as the proportion of early-career IMGs practicing in rural or remote communities was comparable to that of CMGs. This misalignment between policy intent and observed outcomes reinforces the need for appropriate remuneration, supportive work environments and sustained investment in professional development and integration (231).

7.2.3 Physician-related Factors

Individual-level characteristics, including psychological, sociodemographic, values and experiential factors, could also shape decisions to pursue extended training and practice in rural or remote areas. According to John Bowlby's Attachment Theory, people strive for stability, security and meaningful relationships in their social surroundings (102,103). Studies suggest that physicians with a secure attachment style are more likely to choose family medicine and prioritize comprehensive, patient-centred care (103,104). Additionally, the Social Cognitive Career Theory (SCCT) provides an operational framework for understanding how three personal elements: self-efficacy (i.e., the belief in one's ability to succeed), outcome expectations (i.e., anticipated consequences of pursuing a path) and personal goals (i.e., intentions to pursue specific outcomes) may influence physician career choices and practice patterns (101,233,234). Contextually, personal attributes (i.e., gender, cultural background, language proficiency and lived experiences) alongside training-related factors, including training experiences, rural placements and the availability of mentorship, may influence how trainees assess their self-efficacy and outcome expectations. In turn, these experiences could affect decisions about specialty choice and willingness to practice in rural or remote areas.

7.3 Implications for Medical Education and Health Workforce Recommendations

This thesis demonstrates that medical education environments shape the type of training and geographic distribution of family physicians in Ontario. Evidence has shown that the decline in comprehensive care is disproportionately affecting those in underserved communities (235–237). While both studies identify variation across medical schools, neither directly assesses the influence of provincial policy. Nonetheless, broader policy environments may interact with institutional contexts to shape graduate decisions. A multifaceted strategy that integrates medical education

reform with health workforce planning may help address this crisis. This section outlines key implications for admissions policies, curricular design, residency structures and provides complementary policy-centred recommendations to ensure physicians are well-prepared and supported to meet the evolving needs of population health.

7.3.1 Medical Education Environments

A coordinated approach from admissions policies, training structures, to outcome monitoring is essential for reforming medical schools. Admissions processes can be designed to be equity-driven and aligned with population health priorities (92,238). Evidence consistently demonstrates that applicants from particular demographics, such as rural, low-income and historically underrepresented backgrounds, tend to pursue careers in family medicine and practice in underserved communities, with rural students 2.5 times more likely to practice in rural or remote areas (14,68,239–242). Recruiting applicants with characteristics associated with a commitment to primary care, particularly in underserved communities, is a strategic method to improve workforce representation and achieve measurable outcomes.

Amid declining interest in family medicine among graduates, medical schools may aim to increase the proportion of graduates entering comprehensive family medicine (213,240,243,244). Meaningful changes in curricular design and training structures would help facilitate early exposure and sustained engagement. To promote interest in primary care and rural practice, institutions can consider expanding longitudinal exposure to comprehensive care and enhance training opportunities in rural and community settings (245). Several studies have indicated that rural training is one of the strongest predictors of eventual rural practice, underscoring the importance of increasing distributed training models in rural and northern areas in Ontario (17,68,94,97,191,241,246–253). In addition to these efforts, unique initiatives such as designated medical school seats for students with a strong interest in family medicine may lead to long-term engagement. For instance, Queen’s University’s Direct Entry Family Medicine program reserves seats for students committed to the discipline from the outset; however, the long-term impact of this program on the primary care workforce remains under evaluation (254).

Addressing the perception of family medicine as a “fallback” specialty requires changes to both the formal and informal curricula. A cross-sectional study at the University of Alberta found that students who selected family medicine as their first choice demonstrated a stronger professional

identity than those who entered the field after going unmatched in other specialties (255). The hidden curriculum may portray family medicine as less prestigious than other disciplines (256,257). These messages have the potential to influence the professional identity of trainees, negatively altering perceptions of the value of family medicine within the broader medical landscape and thereby reducing their likelihood of practicing in comprehensive primary care (258–260). Possible solutions to addressing this issue include promoting family medicine faculty members into visible leadership roles, investing in primary care research, expanding access to mentorship and recognizing excellence in comprehensive care through awards (261–265).

Lastly, the implementation of transparent, school-specific monitoring mechanisms, such as routine tracking of graduate outcomes by specialty, location and population served, is a crucial step in assessing impact and facilitating continuous improvement (223,266). On its own, tracking graduate outcomes is insufficient without a clear action plan in place. To be effective, the results from these monitoring mechanisms can be integrated into institutional accountability processes, including program evaluations and strategic planning. This integration helps to ensure that medical education policies remain aligned with health system priorities and responsive to the needs of underserved populations.

7.3.2 Additional Recommendation: Health Workforce Planning

While reforms in medical education seek to improve the primary care system, government-level policies are also crucial in ensuring that family physicians are supported throughout their careers. In Canada, an increasing proportion of graduates are pursuing extended training, alongside a concurrent rise in focused practice among family physicians (8,10,47). To counter this shift, decision makers should consider additional strategies that strengthen the primary care workforce and ensure the retention of family physicians in comprehensive and community-based care. Recently, the College of Family Physicians of Canada published a report outlining several solutions, calling on provincial and federal governments to improve integrated care, reform compensation models and enhance care delivery systems (267,268). These recommendations include funding interprofessional collaborative teams, reducing administrative burden, minimizing the challenges associated with adopting new technologies in practice, supporting national licensure and improving locum availability and investing in fair physician remuneration that incentivizes team-based care and accounts for the complexity of patients' needs (269,270).

In addition to remuneration models and practice environments, policies centred on the distribution of physicians, such as Return-of-Service agreements, may benefit from long-term monitoring and formal evaluation. The government of Ontario implemented ROS agreements to increase the number of physicians in underserved areas of the province. However, many IMGs complete their short-term commitments in mid-sized urban centres such as Kingston, Windsor, or Sudbury, which face fewer barriers than truly underserved areas. This issue raises concerns about the effectiveness of ROS policies in addressing both immediate distribution needs and long-term workforce retention (85,86). Following the agreement, IMGs may relocate if the rural or remote community lacks the essential infrastructure, social supports, or professional opportunities needed to maintain long-term practice. To improve the impact of ROS programs, additional financial incentives could be introduced alongside structural supports, such as affordable housing, mentorship and access to continuing professional development, may help encourage long-term practice in rural or remote communities.

7.4 Strengths and Limitations

This thesis presents two cross-sectional cohort studies using the CPSO data to identify two outcomes: the pursuit of extended family medicine training and practice in rural or remote areas. The physician registry provides sociodemographic, training and practice characteristics of graduates of Ontario family medicine residency programs spanning multiple decades. At the same time, the linkage to Statistics Canada's PCCF+ allowed for rural classification of primary practice locations. These methodological strengths offer a robust foundation for analyzing the current state of Ontario's primary workforce and simultaneously generating relevant evidence to inform reforms in medical education and workforce planning.

Nonetheless, key limitations remain. First and foremost, our analysis was restricted to the variables available in the physician registry. The cross-sectional design limits the ability to draw causal inferences or assess practice patterns. Additionally, the physician registry captures only a single postal code, which may not accurately represent multiple practice sites, such as hospital privileges or secondary clinics. Given the small cell sizes, specific Category 1 and all Category 2 programs had to be classified as enhanced skills programs, which may have led to biased estimates and masked program-specific associations. As the dataset only includes residents and licensed physicians practicing in Ontario, our findings are also limited to the province and may not be generalizable to other provinces and/or territories.

The absence of provincial health administrative data, such as those housed at ICES, we were unable to determine whether physicians with extended training deliver comprehensive or focused care, nor could we assess primary care models, panel size, or practice settings. At the same time, several training and sociodemographic variables were unavailable, including specific training site (i.e., whether the physician trained at a main campus or satellite site), rural upbringing, race/ethnicity, gender, age, socioeconomic status and immigration status, all of which are known to influence career trajectories and practice patterns (17,50,68,240,249,271). Despite these constraints, the study yields novel insights into the institutional and physician-level factors that predict the type of training pursued by family physicians and the geographical distribution of the primary care workforce in Ontario. These findings provide a foundation for initial policy reform aimed at building a more responsive, equitable and sustainable primary care system.

7.5 Directions for Future Research

To build on the present findings, future research could link the physician registry with provincial health administrative data to assess longitudinal trends in specialty choice, practice patterns, scope of care and populations served. In parallel, studies are encouraged to examine how intersecting sociodemographic characteristics, such as race/ethnicity, age, gender, rural background and socioeconomic status, potentially influence career trajectories and practice patterns, as this may inform more inclusive medical school policies and effective workforce planning. Furthermore, an important avenue for future research is to examine how the intersection of educational approaches and health system policies shapes career decision-making and practice patterns. These directions represent critical next steps in advancing primary care research in Ontario, amid ongoing efforts to reform the primary care system.

Chapter 8: Conclusion

In the context of Ontario's deepening primary care crisis, this thesis presented two cross-sectional cohort studies using data from the CPSO to address a key question: To what extent do Ontario's medical schools contribute to a socially accountable family medicine workforce? Both studies provide evidence-based insights into the association between medical schools and their graduates' outcomes, particularly in the pursuit of extended family medicine training and practice in rural or remote areas. This thesis is grounded in a SA conceptual framework, which positions medical education environments as a key driver of workforce outcomes, while acknowledging that these outcomes may also be shaped by broader contextual influences such as policy environments and physician-related characteristics. This project is part of an emerging interdisciplinary research program at the intersection of health systems, medical education and health equity. Its findings offer actionable evidence that medical schools and training stakeholders can use to reassess their admissions processes, curriculum design and training placements.

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Appendices

Appendix A: Variable Descriptions from CPSO Dataset

Variables	Description
cpso_num	CPSO registry number
gender	Self identified sex
first_name	First name
last_name	Last name
former_names	Physician's previous name
date_of_death	Death date of physician
address	Address of physician's primary practice location
postal_code	Postal code of physician's primary practice location
pt	Province of physician's primary practice location
mem_status	CPSO member status
mem_status_eff_date	Effective date of CPSO member status
member_expiry_date	Expiry date of CPSO membership
reg_class	CPSO registration class
reg_class_eff_date	Effective date of registration class
language_0 to language_10	Languages spoken (multiple variables)
med_school	Medical school graduated from
med_school_country	Country of medical school
edu_grad_year	Year graduated from medical school
specialty_0 to specialty_8	Specialties listed
specialty_issued_date_0 to _8	Date specialty was issued
reghistory_action_0 to _41	Registration history actions
reghistory_issued_date_0 to _41	Registration history issued dates
postgrad_date_start_0 to _27	Postgraduate training start dates
postgrad_date_end_0 to _10	Postgraduate training end dates

Appendices B: Record Layouts for PCCF+ input files

Variables	Description
POSTALCODE	Six-character postal code
REP_DATE	Reference date for postal code
FSA	Forward Sortation Area
CFSAUD	Census FSA unique identifier
CMA	Census Metropolitan Area code
CMANAME	Census Metropolitan Area name
CSDUID	Census Subdivision unique identifier
CSDNAME	Census Subdivision name
CDUID	Census Division unique identifier
CDNAME	Census Division name
PRUID	Province unique identifier
SAC	Statistical Area Classification code
SACtype	Type of Statistical Area Classification
ERUID	Economic Region unique identifier
FEDNUM	Federal Electoral District number
DGUID	Dissemination geography unique ID
LAT	Latitude (centroid of postal code)
LONG	Longitude (centroid of postal code)
PCMA	Population Centre and Rural Area classification
DBUID	Dissemination Block unique identifier

Appendix C : Statistics Canada - Statistical Area Classification Type (SACtype)

SACtype	Description
1	Census subdivision within census metropolitan area
2	Census subdivision within census agglomeration with at least one census tract
3	Census subdivision within census agglomeration having no census tracts
4	Census subdivision outside of census metropolitan area and census agglomeration having strong metropolitan influence
5	Census subdivision outside of census metropolitan area and census agglomeration having moderate metropolitan influence
6	Census subdivision outside of census metropolitan area and census agglomeration having weak metropolitan influence
7	Census subdivision outside of census metropolitan area and census agglomeration having no metropolitan influence

Appendix D : STROBE Checklist for Cross-Sectional Studies – Objective 1

	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	19,20
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	19,20
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	20,21
Objectives	3	State specific objectives, including any prespecified hypotheses	20,21
Methods			
Study design	4	Present key elements of study design early in the paper	22

Setting	5	Describe the setting, locations and relevant dates, including periods of recruitment, exposure, follow-up and data collection	22,23
Participants	6	(a) Give the eligibility criteria and the sources and methods of selection of participants	22,23
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders and effect modifiers. Give diagnostic criteria, if applicable	23
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	22,23
Bias	9	Describe any efforts to address potential sources of bias	
Study size	10	Explain how the study size was arrived at	24
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	23,24
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	23,24
		(b) Describe any methods used to examine subgroups and interactions	23,24
		(c) Explain how missing data were addressed	22
		(d) If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	23,24
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	41
		(b) Give reasons for non-participation at each stage	41

		(c) Consider use of a flow diagram	41
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	24-30
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	24-30
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	29,30
		(b) Report category boundaries when continuous variables were categorized	
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions and sensitivity analyses	42-45
Discussion			
Key results	18	Summarise key results with reference to study objectives	31-33
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	33
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies and other relevant evidence	31-33
Generalisability	21	Discuss the generalisability (external validity) of the study results	33

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	18
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**Give information separately for exposed and unexposed groups.*

Appendix E : STROBE Checklist for Cross-Sectional Studies – Objective 2

	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	48
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	48,49
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	49,50
Objectives	3	State specific objectives, including any prespecified hypotheses	49,50
Methods			
Study design	4	Present key elements of study design early in the paper	50
Setting	5	Describe the setting, locations and relevant dates, including periods of recruitment, exposure, follow-up and data collection	50
Participants	6	(a) Give the eligibility criteria and the sources and methods of selection of participants	50
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders and effect modifiers. Give diagnostic criteria, if applicable	51
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement).	50

		Describe comparability of assessment methods if there is more than one group	
Bias	9	Describe any efforts to address potential sources of bias	
Study size	10	Explain how the study size was arrived at	52
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	55
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	51,52
		(b) Describe any methods used to examine subgroups and interactions	51,52
		(c) Explain how missing data were addressed	50
		(d) If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	52

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	68
		(b) Give reasons for non-participation at each stage	68
		(c) Consider use of a flow diagram	68
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	52-54
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	52-58
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg,	56,57

		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	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions and sensitivity analyses	69-71
Discussion			
Key results	18	Summarise key results with reference to study objectives	58-60
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	60,61
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies and other relevant evidence	58-60
Generalisability	21	Discuss the generalisability (external validity) of the study results	60,61
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	46

**Give information separately for exposed and unexposed group.*