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The contribution of Memorial University medical graduates to the family physician workforce in Newfoundland and Labrador

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Abstract

Recruiting and retaining family physicians (FP) in rural communities has been an ongoing issue in Canada and other developed nations. The objective of this thesis was to analyze the long-term contribution that Memorial University medical graduate FP made to the physician workforce in Newfoundland and Labrador (NL). We found that 47% of our sample ever worked in NL, 15% ever worked in rural NL and 64% who ever worked in NL stayed for at least 10 years. Being from NL was a predictor of working in NL for at least 5 years and 10 years, respectively. Doing at least some residency at MUN was a predictor of working in rural NL. The study supports policies that encourage the admission of NL students to undergraduate and post-graduate medical programs at Memorial University. Future research should examine retention of Memorial University graduate specialists.

Keywords

Newfoundland and Labrador (NL), Memorial University of Newfoundland (MUN), Family Physician, Physician Workforce, Recruitment, Retention, Rural Physician, Rural Pipeline

Summary for Lay Audience

In Canada, approximately 75% of individuals who do not have a regular family physician live in rural/remote communities. Medical schools are an important resource to increase rural physician supply. For this reason, a number of medical schools, including Memorial University of Newfoundland (MUN) in Newfoundland and Labrador (NL), have implemented a variety of initiatives to attract, train and support rural physicians. Despite these initiatives, rural physician shortages and high physician turnover persists in NL.

Prior research indicated that MUN has substantially contributed to the physician supply in NL, graduating 55.4% of the workforce in 2014. It has also found that students with rural hometowns and students who completed rural residency programs were more likely to enter rural practice. These studies, however, only provide information on the recruitment or short-term retention factors of the NL physician workforce. Therefore, it is important to understand the retention or long-term contribution that MUN family physicians make to the physician workforce.

The overall goal of this thesis was to analyze the long-term contribution that MUN medical graduate FP had on the physician workforce in NL by identifying the predictors of MUN FP who work in NL, work in rural NL, and who work in these locations for 5 and 10 years respectively. We also wanted to identify work-location predictors of physicians who leave NL within 5 and 10 years of starting practice. We used two administrative databases to track MUN FP who graduated between 1997 and 2014 and who began practice in NL between 2000 and 2017.

We found that recruitment and retention of MUN graduates was related to individual physician characteristics and not location specific factors. We found that the biggest contributor to working in NL and rural NL was being from NL and that doing at least some residency at MUN was a predictor of working in rural NL. These findings highlight the need to continue policies that favour acceptance of medical students from NL to contribute further to the physician workforce in NL.

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List of Abbreviations

CFPC	College of Family Physicians of Canada
CIHI	Canadian Institute of Health Information
CME	Continuing Medical Education
FP	Family Physicians
IMG	International Medical Graduate
MMG	Memorial Medical Graduates
MUN	Memorial University of Newfoundland
NL	Newfoundland and Labrador
NOSM	Northern Ontario School of Medicine
RHA	Regional Health Authority
RRM	Rural Roadmap for Action

Chapter 1

1 Introduction

In Canada physicians are most often the first point of contact between the patient and the medical care system (specialists, hospitals, etc.). They deliver care through a wide scope of practice in various settings and to a wide range of populations.[1] When individuals do not have access to a physician, they generally have higher incidences of poor nutrition, chronic disease, injury, and death, often resulting in a shorter life expectancy.[2]

The physician workforce in Canada has seen rapid growth over the last 30 years to the point that it had outpaced the growth of its population.[1] Canadian physicians are now younger and more proportionally represented by gender than any other year in its history and the number of medical school graduates continues to increase each year.

Although the physician workforce in Canada continues to grow and diversify, many individuals, particularly those who work in rural areas (<10,000 population), are still unable to find a regular doctor. Family physicians (FP) represent approximately 50% of the physician workforce but only 8% work in rural and remote communities[1] where roughly 18% of the Canadian population resides.[3] In some provinces 75% of individuals who live in rural/remote communities are without a regular FP.[4]

Newfoundland and Labrador (NL) is one of Canada's most rural provinces. Approximately 40% of the population lives in rural communities spread across a largely northern and remote geographical area.[5,6] Like other rural communities in other provinces, there is a shortage of rural FP in NL. Roughly 23.8% of all physicians in NL serve rural communities[1] and it is estimated that one in five residents find themselves without a regular doctor.[4]

In order to meet the demand for physicians, especially in rural and remote communities, a number of initiatives have been implemented, by medical schools and governments, to select, attract, educate, train and support rural physicians. These initiatives are collectively referred to as the Rural Pipeline Conceptual Model (Section 2.2). These

initiatives begin before individuals apply to medical school. They are based on evidence from previous studies indicating that students with rural origins, and students who have a positive experience with rural medicine are more likely to enter rural/remote practice. For example, previous studies have found that individuals raised in rural communities are two to four times more likely to work in rural areas.[7] For these reasons, some medical schools accept a larger proportion of local medical students and students with rural backgrounds, and they provide outreach and mentorship programs to high schools in these rural communities to spark an interest in a career in family medicine.

The next stage of the conceptual model is initiatives that target medical school itself. Researchers have found that despite additional graduates entering the physician workforce in NL, the proportion of Memorial University of Newfoundland (MUN) medical graduates who worked in rural NL remained stagnant (20.9% in 2014, 20.8% in 2004) and that a smaller proportion of graduates was choosing rural practice than in the previous year.[8] In response, MUN introduced initiatives such as rural curriculum, rural-based faculty members, rural clinical exposure and rural student clubs to boost rural physician supply. MUN, the only medical school in NL, was established to improve the supply of physicians in NL and has a particular focus on producing physicians for its rural communities, specifically FP.[9]

At the post-graduate level, rural pipeline initiatives include residency programs in rural family medicine, rural specialties, additional training in procedural skills and training sites in rural communities. Researchers have found that a large proportion of rural physicians work within close proximity to their postgraduate training site.[10] Findings from a study at Northern Ontario School of Medicine (NOSM) reported that 61% of Canadian medical graduate FP who completed at least some of their training at NOSM practiced in northern Ontario[11] and 94% of NOSM medical degree graduates who completed residency training in northern Ontario are still practicing in northern Ontario between one and three years after graduation.[11,12] Jamieson et al. built on these findings and reported that at two years, residents who trained in distributed sites (outside metropolitan areas) were 15 times more likely to enter rural practice, small towns or regional centres than those who trained in metropolitan centres.[13]

The rural pipeline also included supports to physicians in practice, such as, incentives, locums, and initiatives targeting family and spousal issues (e.g., education for children, work for spouses) and rural economic and community needs. An example of an incentive used in NL is retention bonuses which were designed to encourage rural physicians to provide longer service to the same population/community. Larger bonuses are offered to physicians who remain in the same community for longer periods of time, with higher bonus amounts awarded to physicians serving more rural populations.[14]

Despite efforts, there are many barriers to the recruitment and retention of rural physicians. Most are multifactorial and encompass the complex individual lifestyle choices and influences of physicians throughout the life course. The four most cited reasons for not practicing or for leaving rural/remote practice are high workload, lifestyle issues, family obligations and a lack of professional medical support (professional isolation).[15,16,17]

Many studies assessed the effectiveness of these efforts by examining the number of graduates of medical schools who practice in the regional or rural physician workforce.[8,18,19,20] These studies, however, have traditionally relied on cross-sectional study designs that provide little indication of the length of time a physician has served in each location. As a result, there is little evidence on the impact of the rural pipeline initiatives at a given medical school on physician retention (i.e., duration of practice) in these communities.

1.1 Relevance

MUN has made a substantial contribution to the physician supply in NL, supplying 55.4% of the provincial workforce in 2014.[8] MUN has also contributed to the rural physician workforce in the province, with some reports suggesting that 50% of its medical degree graduates in 2011 and 2012 practicing family medicine in NL were working in rural locations.[9] Studies suggest that the number of MUN family medicine postgraduates (26.9%) practicing in rural/remote locations is also significantly higher than the national average (12.9%).[5]

Despite graduating over 40 classes of physicians, rural physician shortages and high physician turnover persist in the province. While previous studies have provided cross-sectional snapshots of the contribution that Memorial medical graduates (MMG) have made to the provincial and rural workforce, these studies provide little information on the retention of MMG in the province and the long-term contribution that MMG FP have made to the physician workforce.

1.2 Objectives

The current literature is largely made up of cross-sectional studies that provide little information on whether physicians remain in one location for years, if they just started practice in that location or if they returned to this location, potentially overestimating the contribution that MUN trained physicians make to the regional physician supply in NL. Instead of one point in time (cross-sectional), this study used longitudinal study designs that allowed us to analyze the duration of time that MUN medical graduates practiced in NL and in rural communities in NL.

How long did MMG FP work in NL and in its rural communities in NL? The goal of this study was to examine the contribution that newly graduated MMG FP made to the NL primary care workforce between 2000 and 2017.

The research objectives were:

1. To identify the physician-related predictors of MMG FP who worked in NL and who worked in rural communities in NL.
2. To identify the physician-related predictors of MMG FP who left NL and rural NL within five and ten years of starting practice in the province.
3. To identify the work location-related predictors associated with MMG FP who left their work location within five and ten years of starting practice in the location.

Hypotheses:

1. MMG FP who did residency training at MUN, and who had no gap between their post-graduate training and working in NL were more likely to work in NL and to

work in rural NL than MMG FP who did not do residency training at MUN and who had a gap between their post-graduate training and working at MUN.

2. Among MMG FP who ever worked in NL, MMG FP who did residency training at MUN, and who had no gap between their post-graduate training and working in NL were less likely to leave NL and rural NL than MMG FP who did not do residency training at MUN and who had a gap between their post-graduate training and working in NL.
3. Among MMG FP who ever worked in NL, MMG FP worked longer in work locations with higher retention bonuses than work locations with lower retention bonuses.

Chapter 2

2 Literature Review

In Canada, approximately 18% of the population resides in rural areas, yet these areas are served by 8% of its available physicians.[13] The discrepancy between population distribution and physician distribution among urban and rural areas is problematic, leading to health inequity.[21] People who live in rural Canada tend to be older, sicker and poorer than those living in urban Canada.[22,23] Rural Canadians generally have higher incidences of poor nutrition, chronic disease, injury and death, resulting in greater use of the emergency department and a shorter life expectancy than their urban counterparts.[2]

2.1 Physician Workforce

Primary care physicians are called family physicians (FP) and general practitioners (GP). Although the terms are often used interchangeably, FP have passed the College of Family Physicians of Canada (CFPC) certification exam in family medicine and have obtained the CFPC designation. General practitioners, in contrast, have not passed the Canadian family medicine certification examination.[24] For simplicity, we use the term FP to refer to all primary care physicians in this thesis.

FP are conventionally the first point of contact between the patient and medical care system (in the broader health care system, the first point of care may be any front line provider such as a pharmacists or nurse).[1] In Canada, FP function as gatekeepers who, through referrals, control access to secondary (specialists) and tertiary (hospital) care as well as other health services and health care providers. FP deliver care through a wide scope of medical care across a variety of settings. They assess clinical problems presenting at an early stage and diagnose and manage acute and chronic conditions across the life course in a wide range of populations. Specific examples of types of care include, obstetric and postnatal care, palliative and end of life care, in hospital care, home visits and long-term care.[25,26]

2.1.1 Physician Workforce in Canada

The physician workforce in Canada has seen rapid growth over the last 30 years. There were 51,251 physicians across Canada in 1989, which has expanded to 91,375 practicing physicians in 2019.[1] This growing number of physicians is comprised of FP and general practitioners, representing approximately half (46,132) of the physician workforce in Canada.[1]

The Canadian Institute of Health Information (CIHI) reports that the physician to population ratio is increasing so rapidly that the number of physicians has outpaced the growth of the population.[1] In 1989 there were 99 FP per 100,000 individuals in Canada and the ratio has grown to 122 per 100,000 individuals in 2019.[1] Despite the growth, Canada ranks 26th out of 34 developed nations in terms of physician (FP and specialists) to population ratio. The average amongst the participating countries is 310 physicians per 100,000 citizens. Comparatively, Canada has 240 physicians per 100,000 people in the general population based on the Organization for Economic Co-operation and Development (OECD) report.[27]

The gender composition of the physician workforce has also changed. The proportion of female physicians in Canada has continually risen over the last 30 years.[1] In 1989 only 21% of all physicians across Canada identified as female, whereas in 2019, that number nearly doubled to 42.8%.[1] Women physicians differ from men physicians in that they are more likely to choose to practice in family medicine over other specialties.[28] Women in 2019 comprised 47.5% of the FP workforce and 38% of the specialist physician workforce across the country.[1] Women physicians are generally of older age and report working in urban locations more often than men physicians.[29]

In Canada, there continues to be a positive trend in the number of medical school graduates. This influx of new physicians has resulted in a gradual decrease in the average age of physicians over the last 30 years (1989-2019) to an all-time low of 49.4 years in 2019.[1] Physicians in Canada are now younger and more proportionally represented by gender than any other year in its history.

Even though the physician workforce in Canada continues to grow and diversify, many individuals are unable to find a regular doctor. It was reported that between 1995 and 2016 more than 4.6 million Canadians were without a primary care physician.[30] Despite the increase in the physician to population ratio, there is a disparity in the number of physicians that serve rural areas.[13,15] McDonald and Worswick reported that the ratio of physicians per 100,000 individuals in the population in rural areas is forecasted to fall from 79 in 1999 to 53 in 2021.[31] Contributing to this disparity, Gill and colleagues reported that new medical school graduates are increasingly choosing specialist practice over family medicine (more often specialists work in urban communities).[29] They reported that in 1982, 40% of medical students chose family medicine, but in 2010 only 32% of medical students were opting to practice family medicine.[29] To deal with this shortage, Canada has often relied on international medical graduates (IMG), to practice in rural and remote communities. In 2019 IMG made up 26.1% of the physician workforce in Canada with the highest proportion being in Saskatchewan (50.8%) and Newfoundland and Labrador (NL) (34.4%); two of the most rural provinces in the country (2019).[1]

2.1.2 Rural Physician Workforce in Canada

Although FP represent approximately 50% of the physician workforce in Canada, only 13% of FP and 2% of specialists work in rural and remote communities.[1] In reviewing the literature on rural physicians, it is important to note that there is no universal definition of a rural community. Instead there are multiple definitions that are used depending on the country, region, data source and study purpose.[32] Some of these definitions include communities that are 400 square kilometers from a major hospital, communities that are one to four hours travel time in good weather from a major regional hospital, postal codes with 0 as the second digit, or has a population under 100,000.[32] However the classification that most closely reflects common functional differences in practice locations throughout Canada and NL defines a rural community as an area with a population of 10,000 or less and not a suburb or bedroom community of an urban centre.[33]

Compared to physicians who practice in urban areas, physicians who practice in rural areas exhibit a broader scope of practice,[26] see more patients per week, work longer hours, are on call more often and provide more complex care including postnatal care, intrapartum care/deliveries, palliative care, office-based and in-hospital clinical procedures, emergency care, in hospital-care, home visits and long-term care.[26] In a qualitative study, Pong and colleagues reported that most physicians expressed that rural practice was more rewarding, particularly in terms of autonomy, variety of clinical work and respect of patients.[16] However, the average length of time a FP worked in a rural town (<10,000) was just 3.0 years compared to 11.1 years working in small towns (10,000- 29,999).[34]

Studies in Canada and elsewhere indicate that rural physicians are up to five times more likely than their urban counterparts to come from a rural background (often operationalized as having lived in rural communities before the age of 18 or having attended high school in a rural area).[8,25,35] In addition, trainees who had a positive experience training in rural locations during undergraduate and/or postgraduate medical training also show an increased likelihood of practicing in rural locations.[36,37] Students of rural origin, however, are only 56% as likely to apply to medical school in Ontario as students of urban origin, but are admitted at the same rate according to one Ontario study.[38] Approximately 10.8% of medical students in Canada have lived in a rural area compared to roughly 20% of Canada's population.[39]

With only a small proportion of medical students and graduates coming from rural areas, 34-67% of practicing rural physicians are from urban communities.[40] Canadian medical students are also much more likely to come from high income areas and have well-educated, professional parents than the general population.[39] The inability of urban-raised physicians to adapt to rural areas and the demand of rural practice contributes to approximately 18-31% of rural physicians leaving their job each year.[41,42] One in seven rurally practicing physicians report an intention to leave rural practice within the next two years, subsequently moving to urban communities.[43] Rural practicing physicians also retire earlier by an average of 2.3 years.[44]

The reasons for having a long-term rural practice are multifactorial, but rural upbringing, older age at graduation, being in a relationship, completing school in a rural community and expressing a desire for a varied scope of practice are common predictors of a physician practicing in a rural location.[45] There is no indication that gender is a predictor of practicing rurally, although female gender was reported to be a predictor of choosing a career in family medicine.[1,18]

2.1.3 Physician Workforce in Newfoundland and Labrador

NL is Canada's most rural province with a population of 522,000 people in 2020.[46] Of this population, 7% are Aboriginal and approximately 40% live in rural communities (<10,000 population).[5] Almost 40% of the population live in the capital city, St. John's, and the remaining population live in small communities spread across 400,000 square kilometers- a largely northern and remote geographical area.[6] Due to the wide distribution of a small population, often confronted by severe Atlantic weather conditions, access to medical care can be very challenging for individuals living in rural and remote communities that were built around a once prosperous fishing industry.[5]

NL has followed a similar trend as Canada over the last 30 years in that the number of physicians in the province has increased. CIHI reports that in 1989, NL had 168 physicians per 100,000 individuals in the population and in 2019, 260 physicians per 100,000 individuals in the province- surpassing the ratio of physicians to population in the country as a whole.[1] The number of physicians identifying as female has increased and the average age of physicians across the province has decreased.[1] The number of female physicians in the province has grown to 40.2% over the last 30 years and the average age of physicians in the province has become the lowest in the country, with an average age of 48.9 years, in 2019.[1]

Despite these positive trends, there continues to be a shortage of rural FP in NL.[1] Overall, 23.8% of all physicians in NL serve rural communities, 35.5% are rural FP and 11.5% are rural specialist physicians.[1] Even with 692 FP who practice in NL,[1] it is estimated that one in five residents find themselves without a regular doctor and 75% of residents who do not have a regular doctor live in rural areas.[4] This inequity is only going to worsen as

the baby boomer cohort ages, because NL is projected to have the highest proportion of seniors in the country, with approximately 31% of the population expected to be over the age of 65 by 2036.[28] The higher proportion of seniors leads to a higher demand for health services and specifically for FP.[28]

In order to meet the demand for physicians in the province, MUN created a medical school in 1967 specifically to train physicians for practice in rural areas by using a comprehensive pathway approach (see Section 2.2).[9,18,19] MUN has made a substantial contribution to the physician supply in NL, supplying 55.4% of the provincial workforce in 2014.[8] MUN has also contributed largely to the rural physician workforce in the province, with studies reporting that of the physicians working in rural NL between 2004 and 2013, 95.0% were MUN family medicine graduates and 53.7% were Memorial medical graduate (MMG) medical doctors.[5] The number of family medicine post graduates (26.9%) practicing rurally is also significantly better than the national average (12.9%).[5] Although MUN has the highest proportion of rural practicing physicians compared to other medical schools in the country, a critical shortage of FP persists in rural areas.

2.1.4 Barriers to Recruitment and Retention of Rural Physicians

The reasons for the shortage of rural physicians are multifactorial in nature and encompasses the complex individual lifestyle choices and influences of physicians throughout the life course. Moreover, recruitment and retention factors become more complex the further a physician gets from large urban based centres.[47] The most cited reasons, however, for not practicing in a rural area or for leaving rural practice can be grouped into four categories: high workload, lifestyle issues, family obligations and lack of professional medical support (professional isolation).[15,16,17]

The perceived workload of rural physicians can be one of the most influential deterrents to choosing rural and/or remote practice. A study conducted in Ontario reported that physicians practicing in northern Ontario (more rural) worked more hours per week than their southern counterparts (more urbanized), saw fewer patients per week and worked more frequently in clinical group-based practices, providing more complex care and had

a broader scope of practice.[48] This higher workload is believed to lead to burnout in rural practice.

Lifestyle issues and professional isolation are also substantial barriers to recruiting and retaining physicians in rural communities. Many rural and remote physicians find it difficult to achieve a balance between having a professional relationship with a patient and a personal relationship within the community.[49] Other lifestyle issues include lack of appreciation by patients and suboptimal compensation for services provided.[49] The lack of specialty skills backup was cited as a reason to leave rural practice by 63% of physicians in a Canadian study.[43] Curran suggests that newly graduating students are often choosing not to practice in rural communities because they think they do not have the confidence, the skills or the ability to cover rural emergency departments and obstetric care.[50] When in practice, a desire to advance specialist skills training persists, but rural FP report difficulty to finding locum coverage in order to participate in continuing medical education (CME).[49] Other professional isolation issues include a lack of medical role models and other practicing physicians close by, and poor relationships with other practitioners.

Family obligations are also cited frequently as reasons to pursue an urban practice. The inability to find employment opportunities for spouses/partners and lack of educational choices for children are challenging barriers to overcome.[51] Other barriers include a lack of recreational facilities and opportunities due to geographical remoteness.[51] Myroniuk and colleagues found that rural FP stay rural longer if their spouse/partner is able to find work in the rural community.[52] Spouses/partners of rural physicians are essential in order to recruit and retain rural FP, however, it may not be possible to adequately assess educational, professional and cultural needs of a physician's spouse through policy.[52]

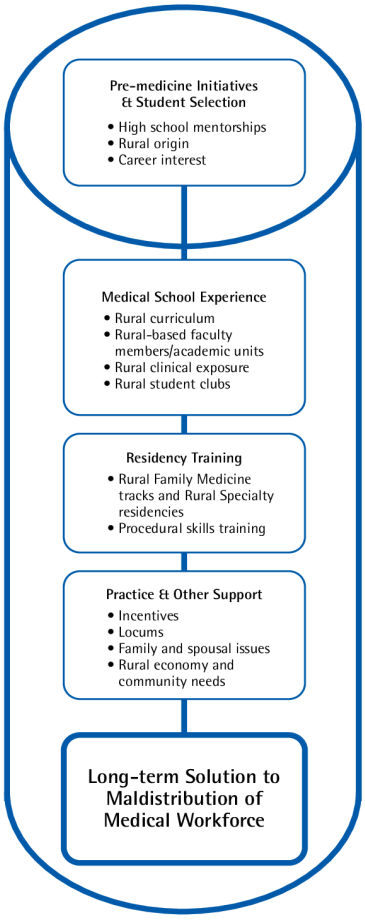
2.2 The Rural Pipeline Conceptual Model

The rural pipeline is a conceptual model used to identify, organize, and design medical education and recruitment and retention initiatives to promote rural practice. The model describes how to select, support, educate and produce physicians for rural practice in a targeted, evidence-based manner.[53] The longitudinal approach demonstrates that

producing, recruiting, and retaining rural physicians begins before medical school (pre-med initiative) and continues by providing exposure and support to rural practice throughout medical school (medical school), during residency (residency training), and throughout practice (practice and other support).[53,54]

The CFPC worked with the Society of Rural Physicians of Canada (SFPC) from 2014-2017 to establish the Rural Roadmap for Action (RRM) to lay the foundation for developing a coordinated and comprehensive approach for using the Pipeline Model.[55] The RRM was developed by Advancing Rural Family Medicine: The Canadian Collaboration Taskforce and released in February 2017.[55]

The RRM taskforce aims to advance the recruitment and retention of FP in rural and remote areas of Canada to improve access to healthcare outcomes for these populations.[54] The taskforce mandate is to develop and provide a guiding framework for a pan-Canadian approach to physician rural workforce planning, as well as access to rural healthcare. It uses a social accountability approach to sharing solutions, by targeting and engaging key stakeholders including rural communities, all levels of government and different components of the healthcare and education systems to work together and implement the rural pipeline conceptual model.[54,55]



Reproduced with permission from Centre for Rural and Northern Health Research at Laurentian University.[16]

Figure 1: Rural Pipeline

2.2.1 Pre-med Incentives

The rural pipeline conceptual model begins with pre-medical school initiatives based on evidence showing that childhood experiences and personal factors related to being educated in rural or other underserviced areas are influential in establishing practices in

rural and remote locations.[18,56] Studies from Canada, the United States, Australia, and the UK have identified that having a rural background strongly predicts practicing in rural communities.[4,18,57]

Szafran et al. reported that having a rural background was associated with perceived preparedness for the non-clinical aspects of having a rural family practice.[58] Some initiatives include admitting students with rural origins and high school mentorship to encourage career interests in medicine.[59] Rourke et al. found that individuals raised in rural communities were two to four times more likely to work in rural areas,[7] while another study reported that more years lived in a rural hometown was a statistically significant predictor of having a rural northern Ontario practice location for FP.[11] A literature review by Grobler et al. also found that many case-control studies reported that having a rural background predicted rural practice.[60] Notably, a study from New Brunswick added that having a rural background and practicing rurally were only significant in FP (not specialists).[61]

Physicians with rural upbringings account for one-third of new rural physicians but remain the main source of physicians in rural communities.[7] Some medical schools have preferential policies with respect to applicants' geography. NOSM has a policy to accept a larger proportion of students from northern Ontario than elsewhere, and MUN has a policy of accepting a larger proportion of students from NL than elsewhere (nationally and internationally).[62] These admission policies build upon the rural pipeline theory that medical students with rural upbringings are more likely to enter rural practice than their urban counterparts; similarly, students from the region are more likely to work in the region than students from outside the region.

Although students from rural areas are more likely to work in rural communities, students with these backgrounds are significantly underrepresented in medical schools. Medical school outreach and mentorship programs were created to address this issue. MedQUEST, in NL, and the Southwestern Ontario Medical Mentorship Program (SWOMMP), in Ontario, are two examples of programs that encourage rural students to pursue medicine. The programs target students in grades 10-12 and are used to expose

secondary students to medical careers by demonstrating that medicine is an achievable career option. The programs also provide longitudinal mentorship to these students in the hopes that they pursue a career in medicine.[63]

High school mentorship programs have shown some success. SWOMMP, for example, has increased high school student's interest in medicine,[63] but it is not known whether they increase the number of rural physicians. Unfortunately, not many such programs have been evaluated.

2.2.2 Medical School

The rural pipeline conceptual model also targets medical school experiences. Initiatives that encourage rural practice in medical school include specifically designed rural curriculum, rural-based faculty members and academic units, rural clinical exposure and rural student clubs.[54]

There are three types of schools that have adopted varying approaches to meeting the need for rural physicians. There are mixed urban/rural schools, which are historically urban-based schools that have expanded their mandate to address the needs of specific rural and remote jurisdictions with which they have developed relationships. Examples of mixed urban/rural schools include the University of Washington in the United States, the University of British Columbia (Prince George campus) in Canada, and Flinders University in Australia. There are de facto rural schools that have a mandate to serve geographic regions (province or state) with substantial rural populations, but they do not necessarily define their role as rural. De facto rural schools include the University of New Mexico in the United States and Memorial University in Canada. Last, there are stand-alone rural schools, such as the NOSM in Canada and James Cook University in Australia, which were specifically created to meet the needs of defined rural and remote regions.[64] Creating stand-alone medical schools in rural areas is the most expensive option but is believed to be the most effective in mitigating the shortage of physicians in rural areas.[64]

An educational policy to aid in the recruitment of rural physicians is the creation and use of specialized rural curricula. This strategy is designed to support and encourage students to choose rural medicine tracks.[59,64] Specialized rural curricula, like those used at NOSM and MUN, focus attention specifically on training physicians for practice that features widely distributed populations across an expansive geographic area. This approach includes focusing on training physicians with the interest, knowledge and skills to practice in rural/remote areas including skills used in clinic, hospitals and patients' homes. The curriculum uses rural-focused, experience-learning-based teaching methods that are often more hands-on and patient focused than urban curricula.[64,65]

The use of rural based curricula has shown some success at multiple medical schools but to what degree they produce rural physicians is somewhat controversial. Completing both undergraduate and post-graduate training at NOSM predicted practicing in rural and northern Ontario locations.[11] In contrast, a 2005 study by Chan and colleagues found that rural education during medical training has a significantly stronger influence on physicians raised in urban areas than on physicians raised in rural communities.[66]

Rural longitudinal integrated clerkships provided in third and fourth year of medical school have also been implemented as an educational model to training and learning the role of a rural physician within the community. They are used to encourage the continued care of a small patient group, providing students with rural training and learning that has positive outcomes.[67] Longitudinal integrated clerkships' are supported by findings that report that medical students interested in treating a comprehensive set of patient presentations are more likely to practice in rural settings.[68]

Rural-based faculty members and academic units are often used and have been very successful but can be very expensive. A study completed at the University of Calgary, tested pilot courses on main campus and at a rural location outside of main campus to understand if rural based educational units could be used instead of building full educational centres (campuses) and yield the same success. They reported that in both pilot courses, there were no significant differences between examination scores of the rural distributed learners and the learners at the main university site. They also received

feedback that small group learning environments used in the rural distributed sites provided strengthened social support.[69] This study helped to support the use of rural distributed sites to provide more positive experiences without losing valuable educational experiences in a traditional classroom.

Myhre et al. reported that graduates from rural programs had significantly higher overall mean scores (when comparing each item within the four domains of care) than urban program graduates for providing postnatal care, intrapartum care/deliveries, palliative/end of life care, office-based clinical procedures, in-hospital clinical procedures, emergency care, in-hospital care, home visits, long-term care and caring for rural and Indigenous populations.[26] Goertzen found similar findings; at graduation, mean experience and competence scores were significantly higher for rural residents than their urban counterparts in 16 procedures including emergency medicine, diagnostic procedures, and management of labour and delivery.[70] A study by Curran and Rourke found that medical students exposed to rural practice during undergraduate training were 1.7 times more likely to choose a career in rural medicine than in urban medicine[47] and a systematic review by Laven and Wilkinson found that rural schooling was also associated with rural practice in all five reviewed studies.[71]

Rural clinical exposure appears to be a valuable experience to medical students, but most findings have been qualitative and are not generalizable to populations beyond the study samples. It was also reported that the rural background effect (medical students with a rural background are more likely to become a rural physician) diminished overtime, suggesting that there could be a lack of training opportunities or practice support once a physician is in practice that help retain these physicians.[56]

Although students might view rural placement positively, their experiences do not necessarily translate to a desire to work in rural locations once they enter practice. Of the students who participate in medical education in primary care settings, students from rural and non-rural backgrounds were highly satisfied with their medical education. Even then, only 10% of these highly satisfied students wanted to work in rural areas, including students from rural communities.[72]

Another study reported that activities and electives based on rural experience had a positive influence on medical students to choose rural practice.[73] A study from NOSM reported that 61% of Canadian medical graduate FP who completed at least some of their training at NOSM practiced in northern Ontario,[11] and rural and remote community placements in 2nd year at NOSM contributed to clinical confidence in medical students.[66] Both studies support the use of medical school initiatives from the rural pipeline theory.

2.2.3 Residency Training

After medical school, residency training is the next milestone that is influential in recruiting and retaining rural physicians. Some initiatives include rural family medicine tracks (specific residency training including urban and rural approaches to be a practicing FP), rural specialty residencies, and procedural skills training to support a wide scope of practice.[74] Cuncic et al. reported that training in rural communities increases the likelihood that graduates practice there.[36] Jamieson et al. built on these findings and reported that after two years, residents who trained in distributed sites were 15 times more likely to enter rural practice, small towns or regional centres than those who trained in metropolitan centres, and that those who trained in distributed sites rated overall preparedness for rural practice higher than those that did not.[13] However, Woloschuk et al. found that spending more time in rural rotations was not associated with likelihood of rural practice.[75]

In Canada and Australia, all medical schools have rural training opportunities.[76] In Canada, in particular, all universities have two family medicine programs, rural and urban, and the number of rural family medicine training programs has expanded from one in 1973 to 16 in 2002.[53] These rural residency programs are based on the premise that the skills and knowledge required for rural practice can best be learned in rural environments themselves.[26] These skills include working with diverse patient populations and using different care options in various settings.[26] The length of residency, flexibility, scope of practice taught, and the relationships with patients were all positive influences on rural career choice.[77]

A study from the University of Calgary found that 72.9% of respondents reported that residency training prepared them to handle the "rural culture" dimension of rural practice.[75] Findings from NOSM reported that approximately 69% of NOSM residents were practicing in northern Ontario, and 94% of NOSM medical degree graduates who completed residency training in northern Ontario were still practicing in northern Ontario, including 33% in smaller communities a decade after graduation.[12]

Lastly, researchers have increasingly found that a large proportion of rural physicians work within close proximity to their postgraduate training site.[10] This finding further emphasizes the importance of creating rural residency training programs and opportunities to expose, produce and keep rural physicians in rural communities.

2.2.4 Practice and Other Support

Lastly, the conceptual model suggests that support throughout the years of medical practice is also important to retaining rural physicians. "Practice support" refers to any support after the completion of residency training. Initiatives to support practice include financial incentives, tuition reimbursement, locums, family and spousal aid, and initiatives to address rural economic and community needs.[54] Policy measures have also been created to help mitigate the shortage of rural physicians such as employing nurse practitioners and physicians assistants and investing in telehealth communications technology in order to reduce the workload of rural physicians.[54]

Family and community influences have been a factor that policy makers have attempted to use to recruit and retain physicians in rural communities. It was reported that lifestyle factors were an important influence for 93.1% of students to practice rurally.[78] One example of this is the ability for spouses/partners to find work in rural areas. Research indicates that rural FP are more likely to stay longer in a rural community if their spouse/partner can find work in the community.[52] Another study, however, found that family influences such as school subsidy fees were not found to be significant overall but were important only to FP with dependent children.[79] A study by Li et al. described four themes of community factors that enhance physician retention: appreciation, connection, active support and physical/recreational assets within the community.[80]

The use of financial incentives is one of the most prominent national and international strategies to create and recruit rural physicians.[54] One example is return for service (RFS) programs. These programs are commonly used to attract physicians to underserved communities by obligating physicians to work in these communities in return for financial support such as bursaries, student loan remission, funded training positions and unrestricted funds.[81] These types of agreements along with the availability of locums, to be able to learn new skills without leaving the community unattended, are important influences on medical students choice to practice rurally.[78]

RFS programs were rated the least desirable solution to the recruitment and retention of rural physicians by rural FP and family medicine residency programs in Ontario[82] but in NL, a larger proportion of physicians with RFS commitments stayed in the province (NL) than those without RFS commitments.[83] Mathews et al. reported that nearly 90% of RFS physicians stayed in NL for four years compared to 60% of non-RFS physicians. At 10 years, 70% of RFS physicians remained in NL compared to 60% of non-RFS physicians. They also found that RFS agreements related to bursary funding were more effective than RFS agreements related to residency position funding.[83]

In 2009, NL introduced Rural Fee for Service Retention Bonuses to physicians across the province. This program requires a physician to have an established relationship with a regional health authority (RHA) and be in active practice. The aim of the program is to strike a balance between recognizing the important contribution that rural physicians make to NL and their joint obligation with the RHA to meet the needs of the public.[14] The idea is that the more rural a community a physician practices in and the more years they spend in that community, the higher the bonus they receive.

Jutzi et al. reported that financial considerations were the most important influences on Ontario medical students' choice to practice in rural communities along with lifestyle considerations.[78] Other studies have found that loan repayment, direct incentives, and residential support programs had the highest service completion rates and physician retention rates.[84] However, according to an Australian qualitative study, financial incentives have not resulted in adequate progress in addressing the physician shortage in

rural/remote communities.[85] Two other studies also reported that incentives and RFS programs were found to have little importance in recruitment and none on retention factors.[81,86]

Rural physicians require locum relief in order to participate in continuing medical education (CME). The availability of locums for rural physicians is reportedly inadequate to meet the demand.[87] Australia reports that increased levels of locum relief incentives and retention payments as well as rural CME have led to increases in the retention of GPs in rural communities.[79] A study from the University of Calgary also found that 94% of rural physicians agreed that CME contributed to increased confidence and alleviated social isolation with 100% of physicians remaining in rural practice five years after participating in CME compared to 71% of physicians who did not participate in CME.[74]

Despite countless attempts to alleviate the shortage of physicians in rural areas, there is no perfect policy and the shortages persist.[88] There is a strong need for a cohesive, comprehensive strategy to recruit and retain rural physicians.[82]

2.2.5 Evaluation of Rural Pipeline

Studies have evaluated medical schools' contributions to the regional physician supply. For example, Hogenbirk et al., in a cross-sectional study, used surveys and medical licensing agency data to examine practice locations of 131 medical graduates who completed undergraduate and/ or post-graduate training at NOSM between 2011 and 2013. This study reported that in September 2014, approximately 21 (16%) FP were practicing in rural northern Ontario and 59 (45%) were practicing in urban northern Ontario. They also reported that approximately 80 (61%) FP graduates who completed at least some training at NOSM had a primary practice location in northern Ontario in September 2014.[11]

The cross-sectional nature of this study only allows the reader to know about practice location for that one-point in time (September 2014). It provides no information on whether physicians remained in one location for years, if they just started practice in that location or if they returned to this location, overestimating the contribution these NOSM

trained physicians make to the regional physician supply in northern Ontario. Instead of one point in time, a longitudinal study provides information on multiple points in time to demonstrate a more accurate understanding of a medical school's contribution over years. The use of surveys also provides another argument against the validity of cross-sectional studies because some researchers argue that the decision to work in rural locations is multifactorial, so physicians may not know and recognize the mechanisms behind their decision to stay in or leave a rural practice.[89]

A study by Wenghofer et al. has similar methodological issues because it is a cross-sectional study assessing rural or northern Ontario practice locations of Canadian medical school graduates from 2009 onward. They used the College of Physician and Surgeons of Ontario database and compared practice locations of certified Ontario FP who graduated from NOSM and compared them to certified Ontario FP who graduated from other Canadian medical schools. They found that approximately two-thirds of physicians that were NOSM-educated were practicing in northern areas, while 25.4% were practicing in rural areas of Ontario. They also found that NOSM undergraduates were more likely to practice in rural Ontario and NOSM postgraduates were more likely to practice in northern Ontario than physicians who were educated at other Canadian medical schools.[90]

2.3 Limitations and Criticisms of the Current Literature

There is a large quantity of literature available on the recruitment and retention of physicians in many countries but specifically in Australia, Canada, and the United States. A large majority of these studies are qualitative or cross-sectional, reporting individual physician responses and odds ratios. The available studies are also retrospective by nature, usually relying on recollections, producing recall and measurement bias.[60] Grobler and colleagues report that, based on Cochrane review standards, there are no well-designed studies that minimize bias and confounding to provide a strong evidence base to support any of the interventions used to address physician shortages in underserved areas.[60] It is important to note that the randomized control trials valued highly in Cochrane reviews are not feasible designs in studying physician recruitment and retention.

Pathman and colleagues reported that the available research has weak methodologies and that chance, bias and confounding are too high, producing low internal validity.[89] Other researchers raise questions about the generalizability of studies because there is no universal definition of rural and suggest that there should be an agreed upon definition of rural and remote for appropriate health policy development, planning and resource allocation.[89,91]

2.3.1 Methodological Limitations of Current Literature

In addition to the methodological issues previously discussed, the one-time analysis of a cross-sectional study does not provide any knowledge on the retention of physicians. Cross-sectional studies also do not allow for causality. The use of pre-existing datasets, such as licensing data from the College of Physicians and Surgeons of Ontario, limits the number of variables that can be examined in any given study.

Multiple cross-sectional studies by Mathews and colleagues have been conducted to evaluate the medical school contribution to NL's physician workforce. One study published in 2006 analyzed MUN medical graduates (1973-1998) work locations in rural Canada and rural NL in 2004 using MUN class lists, alumni databases and post-graduate databases. They reported that approximately 86.8% of MUN medical graduates were working in Canada, 30.7% were working in NL,[20] 12.6% were working in rural Canada, and 6.2% were working in rural communities in NL.[18] They also found that compared to physicians working in urban communities in Canada, a larger proportion of rural physicians had a rural background and did some or all of their residency training at MUN.[18]

A follow-up study analyzed an additional 8 years of MUN medical graduates (1973-2006) and reported that 88.4% of MUN medical graduates were working in Canada. They found that MUN medical graduates now comprised 55.4% of the NL provincial workforce in 2014 compared to 40.9% in 2004.[8] But despite the additional graduates, the proportion of MUN medical graduates who worked in rural NL remained stagnant (20.9% in 2014, 20.8% in 2004) and that a smaller proportion of graduates were choosing rural practice.[8]

While the studies by Mathews and colleagues possess the same methodological issues as the studies by Hogenbirk and Wenghofer, they built a database consisting of administrative data that captured almost 100% of MUN medical degree graduates (limiting the selection bias) and included information about the graduates (rural community, province, and country of origin) that had not previously been collected without a survey (limiting recall bias). The sequential follow-up study 10 years after the initial analysis also identified temporal shifts in physician behaviour.

Although methodologically stronger, as discussed above, the studies are still cross-sectional and only address single points in time. The studies are also only carried out at one medical school in Canada and may not be generalizable to other Canadian medical schools or international ones. These studies did not separate FP from specialist physicians for analysis, which is important because each group has a different set of predictors for practicing in rural communities.[25] Lastly, even with their own administrative database, there was still a fair amount of missing data because graduates without reported work location were presumed to be working outside of the country.

Chapter 3

3 Methods

This thesis consists of three studies, each corresponding to an objective. The first study (objective 1) uses a cross-sectional design with the individual physician as the unit of analysis. The second study (objective 2) uses a cohort design, with the individual physician as the unit of analysis. The third study (objective 3) uses a cohort design with the work location as the unit of analysis.

3.1 Data Source

We conducted secondary analyses of administrative data by linking the Memorial University of Newfoundland (MUN) Medical Graduates Database and the Physician and Medical Practice Database, both held by Dr. Maria Mathews. The MUN Medical Graduates Database was created by compiling data from graduating class lists, the MUN medical alumni, and post-graduate database. The MUN Medical Graduates Database has been used in previous studies.[8,18,19,20] and includes the following variables: year of graduation, gender, hometown, specialty, completion of some or all residency training at MUN, known death, appointment as a military physician, and known retirement.

The Physician and Medical Practice Database is a longitudinal research dataset of physicians who have worked in NL from 2000 to 2017. It was funded by a grant from the Canada Foundation for Innovation and created by linking annual files from the NL provincial health insurance plan, called the Medical Care Plan, of physicians working in NL in each fiscal year. The database included the name of the community where a physician worked each year that the physician worked in NL. The database also included gender, specialty, medical school, and year of graduation. These two datasets were used to construct the variables ‘Gap’, ‘Number of work locations’, ‘Regional Health Authority’, and ‘Retention Bonus Zone’.

Dr. Mathews linked the data from the two databases using first, last and maiden names, gender, medical school, and graduation year. A de-identified dataset (without personal identifiers) was used for the analyses.

3.2 Variables in the Linked Dataset

The following physician-related, location-related and outcome variables were used in the analyses. Physician related variables included, ‘Gender’, ‘Hometown’, ‘From NL’, ‘Year of graduation’, ‘Residency at MUN’ and ‘Gap’. Location related variables included, ‘Number of work locations’, ‘Regional Health Authority’ and ‘Retention Bonus Zone’. Outcome variables included, ‘Ever worked in NL’, ‘Ever worked in rural NL’, ‘Left NL’, ‘Left before 5 years’, ‘Left before 10 years’, ‘Left community’, ‘Left rural NL’, and ‘Started in a rural location’.

3.2.1 Gender [Male, Female]

This variable described the gender indicated on the MUN medical school class list by the medical student. ‘Gender’ was coded as, (0) male and (1) female.

3.2.2 Hometown Classification [Urban, Rural]

This variable described the hometown indicated on the MUN medical school class list. ‘Hometown classification’ was coded as, (0) urban and (1) rural, based on Canadian Statistics Guidelines for rural vs. urban (rural is a population of 10,000 or less).[33] Population was based on the population in the hometown for the year the physician was in the graduation class list to account for changes in community size and classification. We included “bedroom communities” as part of larger urban centres, based on Statistics Canada metropolitan influence zones.[33]

3.2.3 From NL [Yes, No]

This variable described whether a physician was from NL, based on the hometown described on the class list. ‘From NL’ was coded as, (0) not from NL and (1) from NL. Because some table cells had fewer than five physicians, we obscured true values (e.g.

<5). Red, italicized font have been used to identify any results that have been obscured to prevent individuals from being identified.

3.2.4 Year of Graduation [1997-2005 and 2006-2014]

This variable described the year that the student graduated from the undergraduate MUN medical program. 'Year of graduation' was coded as (1) 1997-2005 and (2) 2006-2014. Because some table cells had fewer than five physicians, we obscured true values (e.g. <5). Red, italicized font have been used to identify any results that have been obscured to prevent individuals from being identified.

3.2.5 Residency at MUN [Yes, No]

This variable described whether a physician did some or all his/her residency at MUN. 'Residency at MUN' was coded as, (0) no and (1) yes.

3.2.6 Gap [0-2 years and 3+ years]

This variable described the number of years between a physician's work eligible date after graduation from medical school and his/her first work location in NL. 'Years between work eligible date and first work location in NL' was coded as (0) 0-2 years (no gap) and (1) 3+ years (gap). Because some table cells had less than five physicians, we obscured true values (e.g. <5). Red, italicized font have been used to identify any results that have been obscured to prevent individuals from being identified.

3.2.7 Number of Work Locations in NL [1, 2, 3, 4]

This variable described the number of locations a physician worked between 2000 and 2017. 'Number of work locations' was coded as (1) one location, (2) two locations, (3) three locations and (4) four locations. Because table cells had fewer than five physicians, when we presented these data in tables, we show only three categories. We combined three and four locations for privacy purposes to prevent any individual from being identified. Analyses however were done with the four categories described above.

3.2.8 Started in a Rural Location [Yes, No]

This variable described whether a physician started working in a rural community in NL. ‘Started in a rural location’ was coded as (0) no and (1) yes.

3.2.9 Regional Health Authority [0, 1, 2, 3]

This variable described the NL regional health authority that the physicians practice location was located in. ‘Regional health authority’ was coded as (0) Labrador-Grenfell, (1) Western, (2) Central and (3) Eastern. Because table cells had fewer than five physicians, when we presented these data in tables, we show only three categories. We combined Labrador-Grenfell and Western table cells for security purposes. Analyses however were done with the four categories described above.

3.2.10 Retention Bonus Zone [0, 1, 2, 3]

This variable described the retention bonus zone level that the physician’s practice community was within. ‘Retention bonus zone’ was coded as (0) highest bonus, (1) medium-high bonus, (2) medium-low and (3) lowest (no bonus). Because table cells had fewer than five physicians, when we presented these data in tables, we showed only two categories (bonus and no bonus). We combined highest bonus, medium-high bonus and medium-low bonus for security purposes. Analyses however were done with the four categories described above.

3.2.11 Work in NL in Each Year [Yes, No]

These variables described whether a physician worked in the province each year between 2000 and 2017. Each year represented a unique variable. Each year variable was coded as (0) no and (1) yes.

3.2.12 Work Location in NL

These variables described the community where the physician worked for each year the physician worked in the province between 2000 and 2017. Each year represented a unique variable and was coded as (0) urban or (1) rural, based on the community

population size (10,000 or less is rural).[33] Population was based on the year to account for changes in community size and classification.

3.2.13 Location Size [Urban, Rural]

This variable described the size of a location a physician worked in in NL. ‘Location size’ was coded as (0) urban and (1) rural.

3.2.14 Ever Worked in NL [Yes, No]

This variable described whether a physician ever worked in a community in NL. ‘Ever worked in NL’ was coded as (0) no and (1) yes.

3.2.15 Ever Worked in Rural NL [Yes, No]

This variable described whether a physician ever worked in a rural community in NL. ‘Ever worked in rural NL’ was coded as (0) no and (1) yes.

3.2.16 Left NL [Yes, No]

This variable described whether a physician left NL at some point after they entered practice in NL. ‘Left NL’ was coded as (0) no and (1) yes.

a) Left NL Before 5 Years [Yes, No]

   This variable described whether a physician left NL and/or if they did not stay in NL for at least 5 years at some point after they entered practice in NL. ‘Left NL before 5 years’ was coded as (0) no and (1) yes.

b) Left NL Before 10 Years [Yes, No]

   This variable described whether a physician left NL and/or if they did not stay in NL for at least 10 years at some point after they entered practice in NL. ‘Left NL before 10 years’ was coded as (0) no and (1) yes.

3.2.17 Left Rural NL [Yes, No]

This variable described whether a physician left rural NL at some point after they entered practice in NL. ‘Left rural NL’ was coded as (0) no and (1) yes.

a) Left Rural NL Before 5 Years [Yes, No]

   This variable described whether a physician left rural NL and/or if they did not stay in rural NL for at least 5 years at some point after they entered practice in NL. ‘Left rural NL before 5 years’ was coded as (0) no and (1) yes.

b) Left Rural NL Before 10 Years [Yes, No]

   This variable described whether a physician left rural NL and/or if they did not stay in rural NL for at least 10 years at some point after they entered practice in NL. ‘Left rural NL before 10 years’ was coded as (0) no and (1) yes.

3.2.18 Left Community [Yes, No]

This variable described whether a physician left the community they worked in. ‘Left community’ was coded as (0) no and (1) yes.

3.3 Analyses

We used IBM SPSS Software 27 for all analyses.

3.3.1 Objective 1

The first objective was to identify the predictors of MMG family physicians who ‘Ever worked in NL’ and who ‘Ever worked in rural NL’. To be included in the analysis, individuals had to be a FP and had to have graduated from the undergraduate medical program at MUN, between 1997 and 2014. We limited our analyses to FP because they comprise the vast majority of rural physicians, and the retention and recruitment factors differ between FP and specialists. We limited the sample to FP who graduated between 1997 and 2014 to ensure that we captured all work locations in NL in a physician’s career. Given that family medicine residency training is two years in length, limiting eligible physicians to graduates of the class of 1997 or later, the earliest that they could enter the workforce was 2000 (the first year that work location data are available from the Physician and Medical Practice Database).[19] We were able to identify the work locations of the 2014 graduates for two years (2016-2017).

We excluded physicians who were in the military, from Malaysia, or were known to have died before the end of the study follow-up period. We excluded military physicians because they had limited ability to choose their practice location. We excluded trainees sponsored by the Malaysian government because they were required to return to Malaysia after completing their training. We excluded physicians who died or retired because they were no longer part of the physician workforce.

After describing the characteristics of the sample, we used bivariate analyses (t-tests and chi-squared tests) between each predictor and the outcomes 'Ever worked in NL' and 'Ever worked in rural NL'. Predictors included physician-related variables: 'Gender', 'Hometown classification', 'Year of graduation', 'From NL', Residency at MUN', and 'Gap'. For the outcome 'Ever worked rural NL' we also included the predictor 'Number of work locations'.

We used multivariable logistic regression (a model that investigates the association between a binary outcome and a categorical predictor to consider multiple predictors)[92] to examine the predictors of each of the two outcomes. Covariates for the regression model were selected based on the bivariate analyses. The Wald test was used to determine the significance of variables, where variables that were not significant were removed from the model. The change in -2 Likelihood was used to assess which variables best fit the model. All statistics were two-sided with a significance level of $p < 0.05$. We checked residuals for outliers using z-scores. Any z-score that was above or below 2, was considered an outlier. We tested the hypothesis that FP who did residency training at MUN and FP who had no gap between their post-graduate training and working in NL were more likely to work in NL and to work in rural NL than MMG FP who did not do residency training at MUN and who had a gap between their post-graduate training and working at MUN.

3.3.2 Objective 2

The second research objective was to identify the physician-related predictors of the MMG FP who left NL within five and ten years of starting practice in the province. In these analyses, we excluded MMG FP who never worked in NL from the sample from

the first set of analyses. We excluded MMG who never worked in NL because these analyses examined the predictors of working in NL for five and ten years. In these analyses, we followed MMG for five and ten years after they started working in the province to analyze retention factors. For the five-year follow-up we limited the cohort to graduates from 1997-2011. Graduates from 2011 could begin working in NL in 2013, allowing 5 years of follow-up (to 2017). For the ten-year follow-up, we limited the cohort to graduates from 1997-2006. Graduates from 2006 could begin working in NL in 2008, allowing ten years of follow-up (to 2017). In the main analyses, we considered two dichotomous (yes/no) outcomes: 'Left NL before 5 years', 'Left NL before 10 years'.

For each outcome, after describing the characteristics of the sample, we used bivariate analyses (t-tests and chi-squared tests) to compare those who left and did not leave NL (or rural NL) within five and ten years of starting work in NL. Predictor variables included: 'Gender', 'Rural background', Year of graduation', 'From NL', 'Residency at MUN', 'Gap' (i,e, no gap between work eligible date and first work in NL) and 'Number of work locations'. We used Cox regression (a survival model that is used to relate several variables to survival time simultaneously)[92] to examine the predictors of leaving within 5 and 10 years. Covariates for the regression model were selected based on the bivariate analyses. The likelihood ratio test was used to determine the significance of variables, where variables that were not significant were removed from the model. We checked residuals for outliers using z-scores. Any z-score that was above or below 2, was considered an outlier. All statistics were two-sided with a significance level of $p < 0.05$. We tested the hypothesis that MMG FP who ever worked in NL, who did residency training at MUN, and who had no gap between their post-graduate training and working in NL were less likely to leave NL and to leave a rural community in NL than MMG FP who did not do residency training at MUN and FP who had a gap between their post-graduate training and working in NL.

Normally, when carrying out a survival analysis, we use Kaplan-Meir curves and the log-rank test to assess differences in the length of time before the event by comparing medians. In our data, we found that less than half of the sample had left, so medians

could not be generated. To examine the differences in length to event, we used means and t-tests as part of our bivariate analyses.

In supplementary analyses, we examined FP who remained in rural NL for five years and ten years. For these rural outcomes, we limited the sample to MMG who worked in rural locations and repeated the analyses as described above. These analyses are presented in Appendices D and E.

3.3.3 Objective 3

The third objective was to identify the work location-related predictors associated with MMG FP who left their work location within five and ten years of starting practice in the location. Unlike objective 2, the unit of analysis is each location, rather than the individual physician. As a result, an individual physician who worked in more than one location would represent multiple cases in the dataset (one for each location), with each case including location data specific to a single location.

In objective two, we examined the retention at the physician level. A physician who moved from one location to another in NL would be considered as not having left the province. While the physicians' characteristics remain unchanged (i.e. sex, year of graduation) the characteristics of the different work locations may differ (i.e. urban versus rural). Objective three was designed to allow us to consider the impact of location characteristics on retention. As a result, the variable was whether the physician left the specific location as opposed to the province and considers each location that a physician worked. While location characteristics may have changed, the physician characteristics did not. However, since the analysis looked at each location, physicians (and hence their characteristics) would be overrepresented in the dataset if analyses did not account for the assumption of independence being violated. Analyses of recurrent events deal with these types of issues.

In these analyses we wanted to be able to follow each case for five and ten years. The study sample for the five-year cohort included work locations started between 2000 and 2013 (allowing us to follow a physician who began work in a location in 2013 for 5

years, until 2017). The study sample for the 10-year follow-up cohort was limited to locations started between 2000 and 2008.

In the analyses, we considered two dichotomous (yes/no) outcomes; ‘Left NL before 5 years’, ‘Left NL before 10 years’.

For each outcome, after describing the characteristics of each sample, we used bivariate analyses (t-test and chi-squared tests) to compare locations where physicians did or did not work to the end of the follow-up period. Predictor variables included physicians and locations related variables. Physician variables were: ‘Gender’, ‘Hometown’, ‘Year of graduation’, ‘From NL’, ‘Residency at MUN’ and ‘Gap’ (i,e, no gap between work eligible date and first work in NL). Work locations were: ‘Number of work locations’, ‘Location size’, ‘Regional Health Authority’ and ‘Retention Bonus Zone’.

To account for the recurrent events, we used a Prentice, Williams and Peterson (PWP) Cox regression (a survival model that is used to relate several variables to survival time simultaneously)[92] to examine the predictors of leaving within 5 and 10 years of starting work in the location. Covariates for the regression model were selected based on the bivariate analyses. The likelihood ratio test was used to determine the significance of variables, where variables that were not significant were removed from the model. We checked residuals for outliers using z-scores. Any z-score that was above or below 2, was considered an outlier. All statistics were two-sided with a significance level of $p < 0.05$. We tested the hypothesis that among MMG FP who ever worked in NL, MMG FP would work longer in work locations with higher retention bonuses than work locations with lower retention bonuses.

In the datasets used in these analyses, an individual physician can appear more than once if the physician works in more than one location; that is, an individual physician can have recurring events. A standard Cox regression counts the same characteristics multiple times. This narrows the confidence intervals, and the null hypothesis is rejected more often. To account for recurring events, we used the PWP approach, which analyzes ordered multiple events by stratification, based on the prior number of events during the follow-up period.[93]

To meet the assumptions of the PWP approach, we manipulated the database to allow us to carry out a recurrent analysis consistent with the PWP approach. Specifically, we identified the order of recurring events (location order number) and started the follow-up period from the start of each location (i.e. re-set the clock when work in a location begins).[93] Each work location became a separate record (i.e. case) in the dataset. The retention period was specific to the work location as opposed to the physician (i.e. only covered the period of time a physician spent at a given location, as opposed to the time in NL). We also ensured that physician variables were related to locations (e.g. number of locations worked) and were changed so that they reflected the location and not the individual physician. This applied to the variable 'Number of work locations' (which applies to the physician's career). In these analyses, the variable was changed to reflect which location (first, second, third, fourth) the case represented.

3.4 Ethics

This project was submitted and approved by the Newfoundland and Labrador Health Research Ethics Board (Appendix B) and the Western Research Ethics Manager (Appendix C). To protect confidentiality, Dr. Mathews de-identified the dataset by removing names. Results were presented in aggregate and no individual physician was identified.

Table cells with small sizes were reviewed and numbers were obscured using different techniques depending on the specific variables. For example, as noted above, some variables are reported with fewer categories than were used in the analysis (e.g. Regional health authority). For other dichotomous variables we obscured actual values (e.g. <5), but p-values have not been altered. We use red, italicized text, where applicable, in tables, to indicate where any value has been obscured for privacy reasons. To protect the security of the data we stored the data on a secure password protected computer.

Chapter 4

4 Objective 1 Analyses

Between 1997 and 2014, Memorial University of Newfoundland (MUN) graduated 380 medical students who became family physicians (FP). We excluded three physicians who died, ten who were in the military and seven who were sponsored by the Malaysian government, leaving 361 physicians in this study sample for objective one analyses.

For the outcome "Ever worked in Newfoundland and Labrador (NL)' with 170 yes and 191 no, we can detect a difference of 15% between the two groups, with alpha of 0.05 and beta of 0.8. In the first analysis ('Ever worked in rural NL') with 54 yes and 307 no, we can detect a difference of 26% between the two groups, with an alpha of 0.05 and a beta of 0.8.

4.1 Physician Location Results

The majority of the sample was female (62.6%), from urban hometowns (57.3%), from NL (74.5%), did at least some residency training at MUN (55.4%) and graduated between 2006 and 2014 (53.2%) (Table 1). Less than half (47.1%) of the FP in the sample ever worked in NL and 15.0% ever worked in rural NL. The majority of MUN FP who graduated between 1997 and 2014 never worked in NL (52.9%). Of the FP who ever worked in NL (47.1%), 152 of 170 (89.4%) started working within two years of graduating from MUN medical school and the majority of them (64.7%) worked in one location over the course of their work-life (32.1%) in the province.

Table 1: Characteristics of MUN family physician medical graduates who graduated between 1997 and 2014

Characteristic	No. (%) of family physicians (n = 361)
Gender	
Male	135 (37.4)
Female	226 (62.6)
Hometown classification	
Urban	207 (57.3)
Rural	154 (42.7)
Year of graduation	
1997-2005	169 (46.8)
2006-2014	192 (53.2)
From Newfoundland and Labrador	
No	92 (25.5)
Yes	269 (74.5)
Did at least some residency training at MUN	
No	161 (44.6)
Yes	200 (55.4)
Gap	
0-2 years	152 (42.1)
3+ years	18 (5.20)
No work location in NL	191 (52.9)
Number of work locations	
1 location	110 (30.5)
2 locations	45 (12.5)
3 locations	<15 (<5.00)
4 locations	<5 (<5.00)
No work location in NL	191 (52.9)
Ever worked in Newfoundland and Labrador	
No	191 (52.9)
Yes	170 (47.1)
Ever worked in rural Newfoundland and Labrador	
No	307 (85.0)
Yes	54 (15.0)

MUN= Memorial University of Newfoundland

4.1.1 Ever Worked in Newfoundland and Labrador

Compared to FP who never worked in NL, a larger proportion of FP who worked in NL were from NL (91.2% versus 59.7%; p=0.000) and did at least some residency training at MUN (81.2% versus 32.5% p=0.000) (Table 2). There were no other significant differences between Memorial medical graduate (MMG) FP who ever worked and did not ever work in NL.

Table 2: Characteristics of MUN family physician medical graduates who ever worked in Newfoundland and Labrador between 2000 and 2017

Characteristic	Ever worked in Newfoundland and Labrador, no. (%) of family physicians		
	No (n=191)	Yes (n=170)	p-value
Gender			0.237
Male	66 (34.6)	69 (40.6)	
Female	125 (65.4)	101 (59.4)	
Hometown classification			0.912
Urban	109 (57.1)	98 (57.6)	
Rural	82 (42.9)	72 (42.4)	
Year of graduation			0.930
1997-2005	89 (46.6)	80 (47.1)	
2006-2014	102 (53.4)	90 (52.9)	
From Newfoundland and Labrador			0.000
No	77 (40.3)	15 (8.80)	
Yes	114 (59.7)	155 (91.2)	
Did at least some residency training at MUN			0.000
No	129 (67.5)	32 (18.8)	
Yes	62 (32.5)	138 (81.2)	

MUN= Memorial University of Newfoundland

FP who were from NL were 4.16 times more likely to have worked in NL than FP who were not from NL [OR=4.16, 95% CI (2.16-8.01); p=0.000] (Table 3). FP who had done at least some of their residency training in NL were 6.81 times more likely to have worked in NL than those who had not [OR=6.81, 95% CI (4.10-11.31); p=0.000]. There were no outliers. There were no other significant predictors of working in NL between 2000 and 2017.

Table 3: Predictors of working in Newfoundland and Labrador between 2000 and 2017

Characteristic	Sample Size (n=361)	Location; OR (95% CI) Work in Newfoundland and Labrador	p-value
From Newfoundland and Labrador			0.000
No	92 (25.5)	1.00	
Yes	269 (74.5)	4.16 (2.16-8.01)	
Did at least some residency training at MUN			0.000
No	161 (44.6)	1.00	
Yes	200 (55.4)	6.81 (4.10-11.31)	

MUN= Memorial University of Newfoundland; OR= Odds ratio; CI= confidence interval

4.1.2 Ever Worked in Rural Newfoundland and Labrador

Compared to physicians who worked in urban NL, a larger proportion of FP who worked in rural NL were male (55.6% versus 34.2%; p=0.003), were from NL (88.9% versus 72.0%; p=0.009) and did at least some residency training at MUN (85.2% versus 50.2%; p=0.000) (Table 4). There were no other significant differences of MMG FP working in rural NL.

Table 4: Characteristics of MUN medical graduates who ever worked in rural Newfoundland and Labrador between 2000 and 2017

Characteristic	Ever worked in rural Newfoundland and Labrador, no. (%) of family physicians		
	No (n=307)	Yes (n=54)	p-value
Gender			0.003
Male	105 (34.2)	30 (55.6)	
Female	202 (65.8)	24 (44.4)	
Hometown classification			0.237
Urban	180 (58.6)	27 (50.0)	
Rural	127 (41.4)	27 (50.0)	
Year of graduation			0.705
1997-2005	145 (47.2)	24 (44.4)	
2006-2014	162 (52.8)	30 (55.6)	
From Newfoundland and Labrador			0.009
No	86 (28.0)	6 (11.1)	
Yes	221 (72.0)	48 (88.9)	
Did at least some residency training at MUN			0.000
No	153 (49.8)	8 (14.8)	
Yes	154 (50.2)	46 (85.2)	

MUN= Memorial University of Newfoundland

After controlling for other significant predictors, FP who had done at least some of their residency training at MUN were 5.71 times more likely to have worked in rural NL than those who had not [OR=5.71, 95% CI (2.61-12.51); p=0.000] (Table 5). There were no outliers. There were no other significant predictors of working in rural NL between 2000 and 2017.

Table 5: Predictors of working in rural Newfoundland and Labrador between 2000 and 2017

Characteristic	Sample Size (n=361)	Location; OR (95% CI)	
		Work in rural Newfoundland and Labrador	p-value
Did at least some residency training at MUN			0.000
No	161 (44.6)	1.00	
Yes	200 (55.4)	5.71 (2.61-12.51)	

MUN= Memorial University of Newfoundland; OR= Odds ratio; CI= Confidence interval

4.2 Objective 2 Analyses

In the second set of analyses, we examined the predictors of working in NL for at least 5 and 10 years after starting practice within the province.

4.2.1 Worked in Newfoundland and Labrador for 5 Years

In the 5-year analyses, we restricted the sample to MMG FP who ever worked in NL. To allow for a follow-up period of 5 years, we excluded MMG who began practice after 2013 (n=22). There were 148 MMG FP in the analyses. With 51 FP who worked in NL for 5 years (yes) and 97 FP who did not (no), we can detect a difference of 26.5% between the two groups, with an alpha of 0.05 and a beta of 0.8.

The majority of the cohort was female (57.4%), from urban hometowns (57.4%), from NL (91.2%), did at least some residency training at MUN (82.4%) and graduated between 1997 and 2005 (54.1%) (Table 6). Most FP that worked in NL for 5 years did not have a gap (90.5%), worked in just one location (61.5%), never worked in rural NL (69.6%) and started working in an urban location (73.0%).

Compared to physicians who left the province within 5 years, FP who worked in NL for 5 years were from NL (91.2% versus 8.8%; p=0.000) and graduated between 2006 and 2011 (52.6% versus 33.3%; p=0.026) (Table 6). There were no outliers. There were no other significant differences between those who left and those that did not leave NL within the first 5 years of practice.

Table 6: Characteristics of family physicians who left and did not leave Newfoundland and Labrador within the first 5 years of practice in Newfoundland and Labrador

Characteristic	Study Sample (n=148) n (%)	Mean (Standard Deviation)	p-value*	Left Province		p-value**
				No (n=97)	Yes (n=51)	
Gender			0.920			0.919
Male	63 (42.6)	4.57 (0.98)		41 (42.3)	22 (43.1)	
Female	85 (57.4)	4.45 (1.08)		56 (57.7)	29 (56.9)	
Hometown classification			0.553			0.550
Urban	85 (57.4)	4.49 (0.98)		54 (55.7)	31 (60.8)	
Rural	63 (42.6)	4.51 (1.11)		43 (44.3)	20 (39.2)	
From NL			0.000			0.000
No	13 (8.80)	3.62 (1.50)		*<5 (<6.00)*	*<16 (<32.0)*	
Yes	135 (91.2)	4.59 (0.94)		*<97 (<94.0)*	*<35 (<69.0)*	
Year of graduation			0.026			0.026
1997-2005	80 (54.1)	4.46 (1.09)		46 (47.4)	34 (66.7)	
2006-2011	68 (45.9)	4.54 (0.97)		51 (52.6)	17 (33.3)	
Did at least some residency at MUN			0.639			0.636
No	26 (17.6)	4.19 (1.30)		16 (16.5)	10 (19.6)	
Yes	122 (82.4)	4.57 (0.96)		81 (83.5)	41 (80.4)	
Gap			0.490			0.487
0-2 years	134 (90.5)	4.54 (1.01)		89 (91.8)	45 (88.2)	
3+ years	14 (9.50)	4.07 (1.21)		8 (8.20)	6 (11.8)	
Number of work locations			0.352			0.525
1 location	91 (61.5)	4.43 (1.13)		61 (62.9)	30 (58.8)	
2 locations	42 (28.4)	4.64 (0.85)		28 (28.9)	14 (27.5)	
3 and 4 locations	*15 (10.1)*	9.36 (1.03)		*8 (8.30)*	*7 (13.8)*	

Ever worked in a rural location			0.352			0.349
No	103 (69.6)	4.46 (1.11)		70 (72.2)	33 (64.7)	
Yes	45 (30.4)	4.60 (0.84)		27 (27.8)	18 (35.3)	
Started in a rural location			0.102			0.101
No	108 (73.0)	4.48 (1.09)		75 (77.3)	33 (64.7)	
Yes	40 (27.0)	4.55 (0.88)		22 (22.7)	18 (35.3)	

MUN= Memorial University of Newfoundland; NL= Newfoundland and Labrador
Red and italicized figured have been modified for security reasons because cell sizes were smaller than 5
*From t-test or ANOVA
**From chi-squared test

The only predictor of working in NL for at least 5 years was being from NL [OR= 0.297, 95% CI (0.129-0.681); p= 0.004)]. MMG FP from NL were 3.37 times less likely (or 0.297 times as likely) to leave within the first 5 years of practice in NL than those not from NL (Table 7). There were no outliers. There were no other significant predictors of leaving practice in NL before 5 years.

Table 7: Predictors of working in Newfoundland and Labrador for at least 5 years based on total time spent working in Newfoundland and Labrador

Characteristic	Study Sample (n=148)	Odds Ratio (95% CI)	p-value
From Newfoundland and Labrador			0.004
No	13 (8.80)	1.00	
Yes	135 (91.2)	0.297 (0.129-0.681)	

CI= confidence interval

Figure 2 shows the survival curve for FP in the cohort. As shown, 77.6% of FP did not leave NL for 5 years after starting practice in the province.

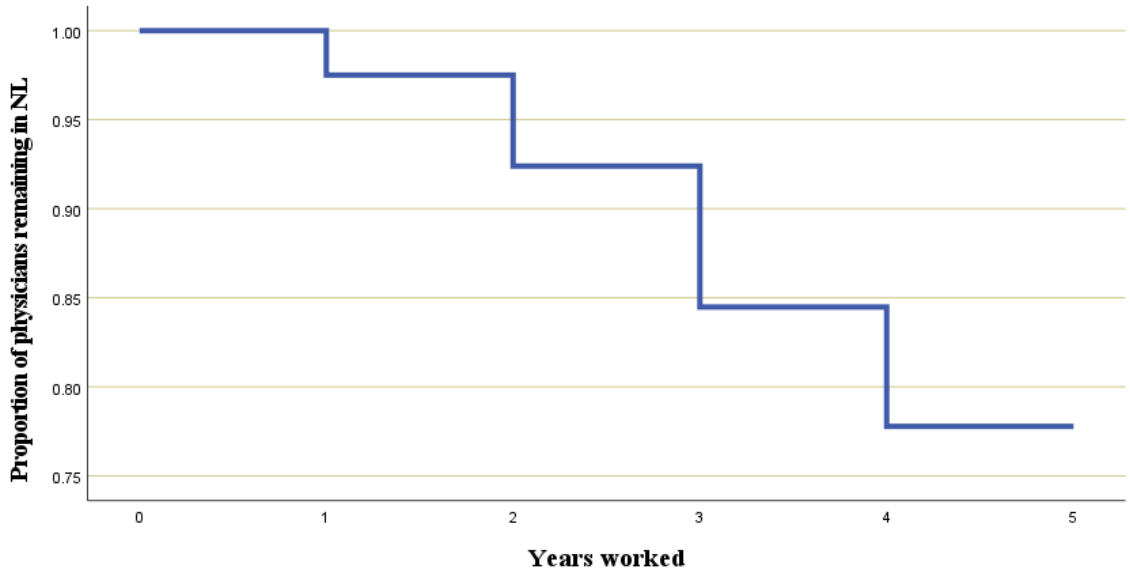


Figure 2: Proportion of MMG family physicians who remain in Newfoundland and Labrador for at least 5 years

4.2.2 Worked in Newfoundland and Labrador for 10 Years

The majority of the cohort was female (55.3%), from urban hometowns (55.3%), from NL (89.4%), did at least some residency training at MUN (84.7%) and graduated between 1997 and 2005 (90.6%) (Table 8). Most FP that worked in NL for 10 years did not have a gap (92.9%), worked in just one location (49.4%), never worked in rural NL (68.2%) and started working in an urban location (71.8%)

Compared to physicians who left the province within 10 years, FP who worked in NL for 10 years were from NL (100.0% versus 75.0%; p=0.000) (Table 8). There were outliers. There were no other significant differences between those who left and those that did not leave NL before 10 years of practice.

Table 8: Characteristics of family physicians who left and did not leave Newfoundland and Labrador within the first 10 years of practice in Newfoundland and Labrador

Characteristic	Study Sample (n=85) n (%)	Mean (Standard Deviation)	p-value*	Left Province		p-value**
				No (n=49)	Yes (n=35)	
Gender			0.361			0.355
Male	38 (44.7)	8.21 (2.94)		24 (49.0)	14 (38.9)	
Female	47 (55.3)	7.38 (3.34)		25 (51.0)	22 (61.1)	
Hometown classification			0.634			0.629
Urban	47 (55.3)	7.62 (3.19)		26 (53.1)	21 (58.3)	
Rural	38 (44.7)	7.92 (3.20)		23 (46.9)	15 (41.7)	
From NL			0.000			0.000
No	9 (10.6)	4.44 (2.30)		0 (0.00)	9 (25.0)	
Yes	76 (89.4)	8.14 (3.05)		49 (100.0)	27 (75.0)	
Year of graduation			0.774			0.770
1997-2005	77 (90.6)	7.82 (3.11)		<44 (<90.0)	<30 (<86.0)	
2006	8 (9.40)	7.13 (3.98)		<5 (<10.0)	<5 (<14.0)	
Did at least some residency at MUN			0.776			0.763
No	13 (15.3)	7.00 (3.54)		7 (14.3)	6 (16.7)	
Yes	72 (84.7)	7.89 (3.12)		42 (85.7)	30 (83.3)	
Gap			0.698			0.694
0-2 years	79 (92.9)	7.85 (3.13)		<44 (<90.0)	<30 (<86.0)	
3+ years	6 (7.10)	6.50 (3.83)		<5 (<10.0)	<5 (<14.0)	

Number of work location			0.447			0.709
1 location	42 (49.4)	7.21 (3.47)		22 (44.9)	20 (55.6)	
2 locations	30 (35.3)	8.40 (2.75)		19 (38.8)	11 (30.6)	
3 and 4 locations	*13 (15.3)*	7.33 (3.43)		*8 (16.3)*	*5 (13.9)*	
Ever worked in rural NL			0.793			0.790
No	58 (68.2)	7.64 (3.24)		34 (69.4)	24 (66.7)	
Yes	27 (31.8)	8.00 (3.08)		15 (30.6)	12 (33.3)	
Started in a rural location			0.377			0.371
No	61 (71.8)	7.75 (3.20)		37 (75.5)	24 (66.7)	
Yes	24 (28.2)	7.75 (3.18)		12 (24.5)	12 (33.3)	

MUN= Memorial University of Newfoundland; NL= Newfoundland and Labrador
Italicized figures have been modified for security reasons because cell sizes were smaller than 5
* From t-test or ANOVA
** from chi-squared test

The only predictor of working in NL for at least 10 years was being from NL [OR= 0.197, 95% CI (0.090-0.433); p= 0.000)] (Table 9). MMG FP from NL were 5.08 times less likely (or 0.197 times as likely) to leave within 10 years of practice in NL than those not from NL. There were no outliers. There were no other significant predictors of leaving practice in NL before 10 years.

Table 9: Predictors of working in Newfoundland and Labrador for at least 10 years based on total time spent working in Newfoundland and Labrador

Characteristic	Study Sample (n=85)	Odds Ratio (95% CI)	p-value
From Newfoundland and Labrador			0.000
No	9 (10.6)	1.00	
Yes	76 (89.4)	0.197 (0.090-0.433)	

CI= confidence interval

Figure 3 shows the survival curve for FP in the cohort. As shown, 64.3% of MMG FP did not leave NL for 10 years after starting practice in the province. All MMG who did not leave NL for at least 8 years remained in NL for the full 10 years.

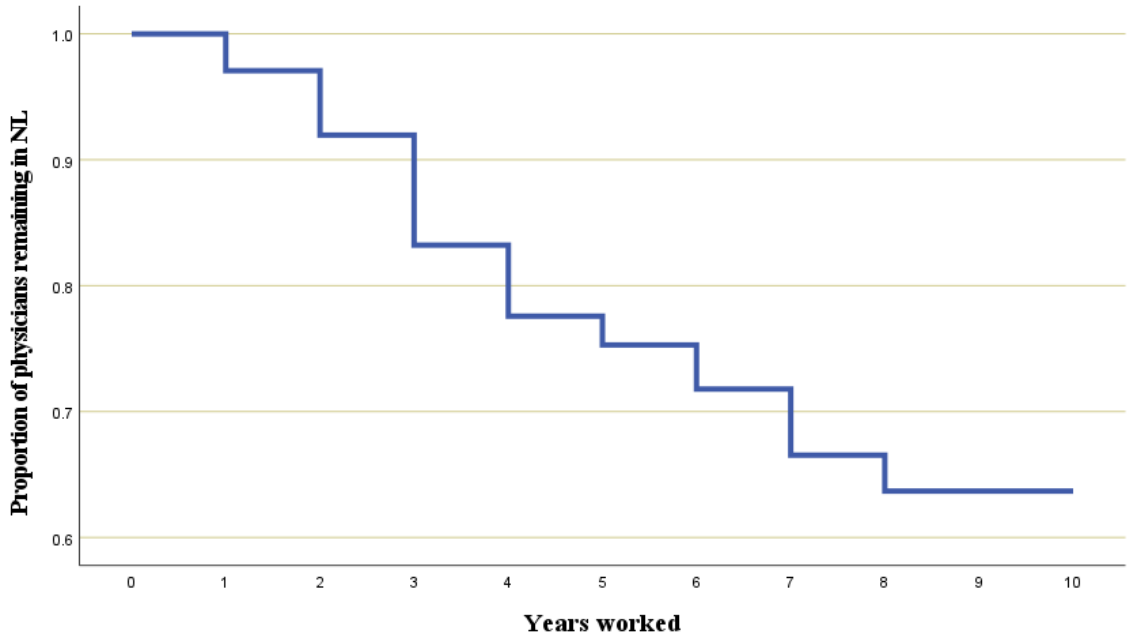


Figure 3: Proportion of MMG family physicians who remain in Newfoundland and Labrador for at least 10 years of practice

4.3 Objective 3 Analyses

In the third set of analyses, we examined the predictors of practice locations being worked in NL for at least 5 and 10 years, not the physician characteristics analyzed in objectives one and two. By this we mean locations that retain their FP. In these analyses, we looked at retention in each location. Unlike the previous analyses, each case represents a single location (rather than a single FP). FP with multiple locations will appear in the data set multiple times (one for each location). While FP characteristics will not change for each case, the location characteristics will.

4.3.1 Locations Worked for at 5 Years

In the 5-year cohort, we restricted the sample to locations that could be followed for 5 years. To allow for a follow-up period of 5 years, we excluded work in locations that

began after 2013 (n=216). There were 224 locations in the analysis. With 50 locations that were left within 5 years (yes) and 174 who did not (no), we can detect a difference of 27% between the two groups, with an alpha of 0.05 and a beta of 0.8.

The majority of locations were worked at for 5 years by physicians who were female (54.9%), from urban hometowns (55.4%), were from NL (90.6%), who graduated between 1997 and 2005 (99.1%) and who did at least some residency at MUN (84.4%) (Table 10). The majority of locations worked in were first locations (66.1%), in the Eastern regional health authority (65.6%) and in the lowest retention bonus zone (81.3%).

Compared to locations that were not worked in for 5 years, locations that were worked at for 5 years were more likely to be worked at by a physician who was male (49.4% versus 30.0%; p=0.015), was from NL (94.8% versus 76.0%; p=0.000), did at least some residency at MUN (87.4% versus 74.0%; p=0.022) and who did not take a gap between graduation and first work location (95.4% versus 84.0%; p=0.006) (Table 10). There were no outliers. There were no other significant differences of locations in NL being practiced in for at least 5 years.

Table 10: Characteristics of practice locations in Newfoundland and Labrador worked in for at least 5 years

Characteristic	Study Sample (n=224) n (%)	Mean (Standard Deviation)	p-value*	Left Location		p-value**
				No (n=174)	Yes (n=50)	
Gender			0.014			0.015
Male	101 (45.1)	4.70 (0.82)		86 (49.4)	15 (30.0)	
Female	123 (54.9)	4.41 (1.07)		88 (50.6)	35 (70.0)	
Hometown classification			0.813			0.454
Urban	124 (55.4)	4.53 (0.94)		94 (54.0)	30 (60.0)	
Rural	100 (44.6)	4.55 (1.02)		80 (46.0)	20 (40.0)	
From NL			0.017			0.000
No	21 (9.40)	3.62 (1.40)		9 (5.20)	12 (24.0)	
Yes	203 (90.6)	4.64 (0.87)		165 (94.8)	38 (76.0)	
Year of graduation			0.000			0.326
1997-2005	130 (58.0)	4.58 (0.97)		104 (59.8)	26 (52.0)	
2006-2011	94 (42.0)	4.49 (0.98)		70 (40.2)	24 (48.0)	
Did at least some residency at MUN			0.502			0.022
No	35 (15.6)	4.20 (1.21)		22 (12.6)	13 (26.0)	
Yes	189 (84.4)	4.60 (0.92)		152 (87.4)	37 (74.0)	
Gap			0.030			0.006
0-2 years	208 (92.9)	4.59 (0.94)		166 (95.4)	42 (84.0)	
3+ years	16 (7.10)	3.94 (1.18)		8 (4.60)	8 (16.0)	
Number of work location			0.000			0.705
1 location	148 (66.1)	4.50 (1.03)		114 (65.5)	34 (68.0)	
2 locations	57 (25.4)	4.61 (0.86)		*<46 (<26.5)*	<11 (<22.0)	
3 and 4 locations	*19 (8.50)*	*4.53 (0.92)*		*<14 (8.00)*	*<5 (<10.0)*	

Regional Health Authority			0.170			0.428
Western	*39 (17.4)*	*4.68 (0.88)*		*32 (18.4)*	*7 (14.0)*	
Central	38 (17.0)	4.79 (0.47)		31 (17.8)	7 (14.0)	
Eastern	147 (65.6)	4.46 (1.07)		111 (63.8)	36 (72.0)	
Retention Bonus Zone			0.194			0.745
Bonus	*42 (18.7)*	*4.64 (0.72)*		*32 (18.3)*	*10 (20.0)*	
No Bonus	182 (81.3)	4.52 (1.01)		142 (81.6)	40 (80.0)	

MUN= Memorial University of Newfoundland; NL= Newfoundland and Labrador
Italicized figures have been modified for security reasons because cell sizes were smaller than 5
* From t-test or ANOVA
** from chi-squared test

Only physician related characteristics were significant predictors of a physician working in a location for 5 years. The only significant predictors were, female gender [OR= 2.198, 95% CI (1.229-3.934); p= 0.008)] and being from NL [OR= 0.151, 95% CI (0.081-0.283); p= 0.000)] (Table 11). Women physicians were 2.20 times as likely to leave a location within 5 years compared to men. A physician from NL was 6.62 times less likely (or 0.151 times as likely) to leave within 5 years than FP who were not from NL. There were no outliers. There were no other significant predictors.

Table 11: Predictors of locations worked in Newfoundland and Labrador for at least 5 years

Characteristic	Study Sample (n=224)	Odds Ratio (95% CI)	p-value
Gender			0.008
Male	101 (45.1)	1.00	
Female	123 (54.9)	2.198 (1.229-3.934)	
From Newfoundland and Labrador			0.000
No	21 (9.40)	1.00	
Yes	203 (90.6)	0.151 (0.081-0.283)	
CI= confidence interval			

Figure 4 shows the survival curve for practice locations in the cohort. As shown, 82.4% of locations had a retention of at least 5 years.

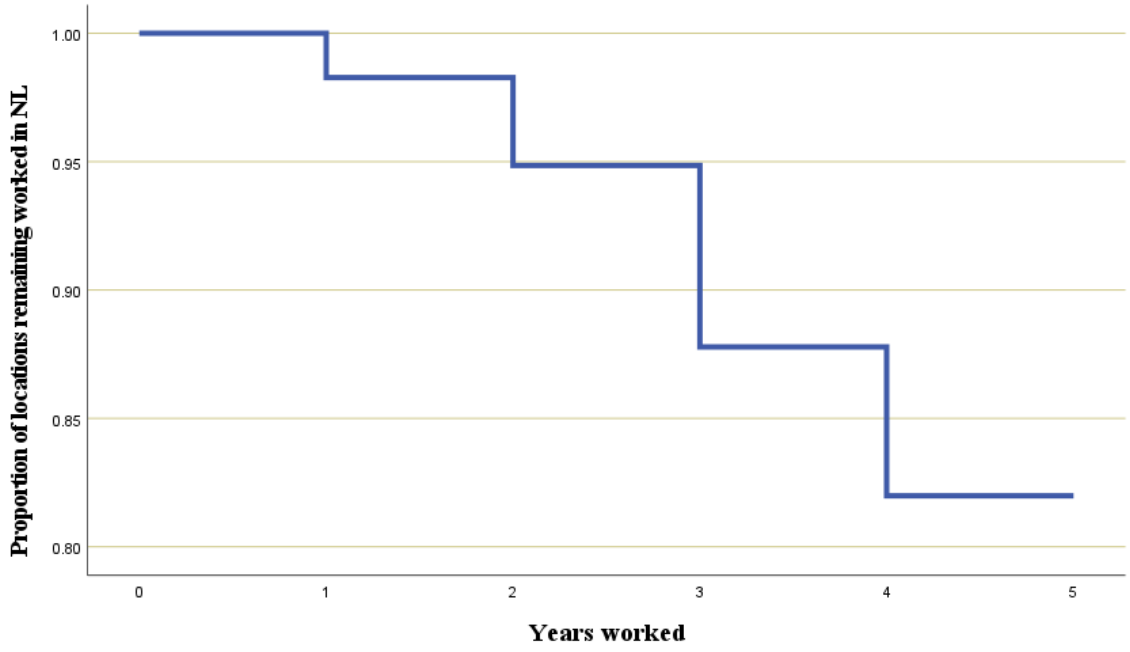


Figure 4: Proportion of locations worked in Newfoundland and Labrador for at least 5 years

4.3.2 Locations Worked for 10 Years

In the 10-year cohort, to allow for a follow-up period of 10 years, we excluded locations where physicians started working after 2008 (n=295). There were 145 locations in the analysis. With 50 locations that were left within 10 years (yes) and 93 that were not (no),

we can detect a difference of a difference of 27% between the two groups, with an alpha of 0.05 and a beta of 0.8.

The majority of locations that were worked at for 10 years were worked at by physicians who were female (53.1%), from urban hometowns (51.0%), were from NL (89.7%), who graduated between 1997 and 2005 (87.6%) and who did at least some residency at MUN (86.9%) (Table 12). The majority of locations worked in were first locations (58.6%), in the Eastern regional health authority (69.0%) and in the lowest retention bonus zone (82.8%).

Compared to locations that were not worked in for 10 years, locations that were worked at for 10 years were more likely to be worked at by a physician who was male (54.8% versus 32.7%; p=0.010) and was from NL (100.0% versus 71.2%; p=0.000) (Table 12). There were no outliers. There were no other significant differences of a practice location being worked in for at least 10 years.

Table 12: Characteristics of practice locations in Newfoundland and Labrador worked in for at least 10 years

Characteristic	Study Sample (n=145) n (%)	Mean (Standard Deviation)	p-value*	Left Community		p-value**
				No (n=93)	Yes (n=50)	
Gender			0.180			0.010
Male	68 (46.9)	8.78 (2.44)		51 (54.8)	17 (32.7)	
Female	77 (53.1)	7.27 (3.30)		42 (45.2)	35 (67.3)	
Hometown classification			0.284			0.631
Urban	74 (51.0)	7.28 (3.07)		46 (49.5)	28 (53.8)	
Rural	71 (49.0)	8.14 (2.97)		47 (50.5)	24 (46.2)	
From NL			0.094			0.000
No	15 (10.3)	4.27 (2.15)		0 (0.00)	15 (28.8)	
Yes	130 (89.7)	8.41 (2.80)		93 (100.0)	37 (71.2)	
Year of graduation			0.253			0.775
1997-2005	127 (87.6)	8.11 (2.88)		82 (88.2)	45 (86.5)	
2006	18 (12.4)	7.06 (3.81)		11 (11.8)	7 (13.5)	
Did at least some residency at MUN			0.863			
No	19 (13.1)	7.26 (3.41)		11 (11.8)	8 (15.4)	0.543
Yes	126 (86.9)	8.09 (2.95)		82 (88.2)	44 (84.6)	
Gap			0.058			0.106
0-2 years	137 (94.5)	8.12 (2.93)		<88 (<95.0)	<45 (<90.0)	
3+ years	8 (5.50)	5.63 (3.62)		<5 (<5.00)	<5 (<10.0)	
Number of work location			0.000			0.904
1 location	85 (58.6)	7.75 (3.18)		53 (57.0)	32 (61.5)	
2 locations	43 (29.7)	8.28 (2.81)		29 (31.2)	14 (26.9)	
3 and 4 locations	*17 (11.8)*	*8.00 (3.03)*		*11 (11.8)*	*6 (11.5)*	

Regional Health Authority			0.227			0.722
Western	*20 (13.8)*	*10.00 (0.00)*		*15 (16.2)*	*5 (9.60)*	
Central	25 (17.2)	8.55 (2.72)		16 (17.2)	9 (17.3)	
Eastern	100 (69.0)	7.87 (3.05)		62 (66.7)	38 (73.1)	
Retention Bonus Zone			0.092			0.362
Bonus	*25 (17.3)*	*7.33 (4.62)*		*19 (20.4)*	*6 (11.5)*	
No Bonus	120 (82.8)	7.75 (3.16)		74 (79.6)	46 (88.5)	

MUN= Memorial University of Newfoundland; NL= Newfoundland and Labrador
Italicized figures have been modified for security reasons because cell sizes were smaller than 5
* From t-test or ANOVA
** from chi-squared test

Only physician related characteristics were significant predictors of a location being practiced in for 10 years. The only significant predictors were, female gender [OR= 2.509, 95% CI (1.113-5.654); p=0.027)], being from NL [OR= 0.176, 95% CI (0.076-4.07); p=0.000)], graduating between 1997 and 2005 [OR= 2.773, 95% CI (1.126-6.828) p=0.027)] and doing at least some residency at MUN [OR= 0.343, 95% CI (0.135-0.873); p=0.025)] (Table 13). There were no outliers. There were no other significant predictors of a practice location in NL being worked in for at least 10 years.

Table 13: Predictors of locations worked in Newfoundland and Labrador for at least 10 years

Characteristic	Study Sample (n=145)	Odds Ratio (95% CI)	p-value
Gender			0.027
Male	68 (46.9)	1.00	
Female	77 (53.1)	2.509 (1.11-5.65)	
From Newfoundland and Labrador			0.000
No	15 (10.3)	1.00	
Yes	130 (89.7)	0.176 (0.08-4.07)	
Year of graduation			0.027
1997-2005	127 (87.6)	1.00	
2006	18 (12.4)	2.773 (1.13-6.83)	
Did at least some residency at MUN			0.025
No	19 (13.1)	1.00	
Yes	126 (86.9)	0.343 (0.14-0.87)	

MUN= Memorial University of Newfoundland

Figure 5 shows the survival curve for practice locations in the cohort. As shown, 64.1% of locations had a retention of at least 10 years.

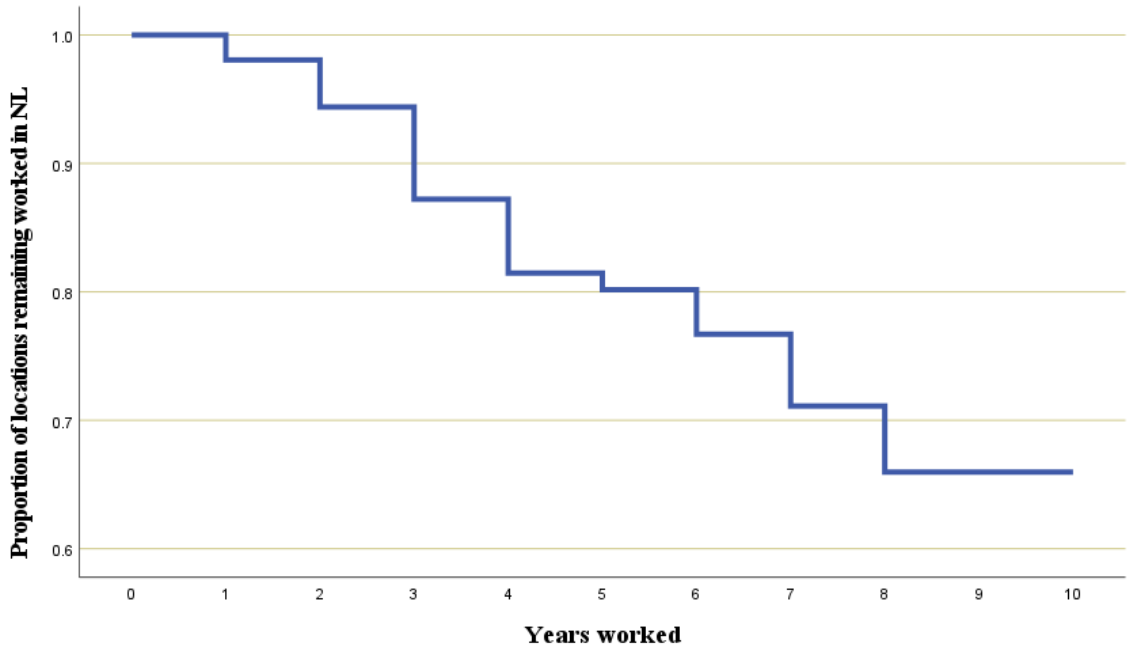


Figure 5: Proportion of locations worked in Newfoundland and Labrador for at least 10 years

Chapter 5

5 Discussion

This thesis used a longitudinal study design to analyze the duration and location of practice in Newfoundland and Labrador (NL) between 2000 and 2017 for Memorial medical graduate (MMG) family physicians (FP) who graduated between 1997 and 2014. We did this to analyze our hypotheses that MMG FP who never left NL for their training were more likely to work in NL, to work in rural NL and to work for longer durations than those who left NL.

Ninety-seven FP worked in NL for at least 5 years and 49 FP worked in NL for at least 10 years. FP worked in one to four locations. There were 174 (77.6%) locations that had retention for 5 years and 93 (64.1%) that had retention of at least 10 years. Retention of physicians was related to physician characteristics rather than location attributes.

5.1 Overview of Results

We found that of the 361 FP who graduated from Memorial University of Newfoundland (MUN) between 1997 and 2014, 47.1% (170) ever worked in NL and 15.0% (54) ever worked in rural NL for any period of time between 2000 and 2017. These findings were higher than previous cross-sectional studies that found 30.7% of MMG FP worked in NL and 6.2% worked in rural NL in 2004[18] and 34.2% of MMG FP worked in NL and 4.9% in rural NL in 2014.[8] These findings are consistent however, with the national average of 12.9% of all FP in Canada that work in rural/remote communities.[1,21]

5.1.1 Working in NL and Rural NL

Our analyses found that MMG FP who were from NL were 4.16 times more likely to have worked in NL than MMG FP who were not from NL and MMG FP who had done at least some residency training at MUN were 6.81 time more likely to have worked in NL than those who had not. These findings were consistent with previous studies in NL,[8,18,20] as well as other studies that report physicians work in close proximity to their residency site.[10]

MMG FP who had done at least some residency training at MUN were 5.71 times more likely to have worked in rural NL than those who had not. This finding was again consistent with previous studies that concluded that residency at MUN specifically predicts working in rural NL.[8,18,19,20] The results confirm our hypothesis that MMG FP who did residency training at MUN were more likely to work in NL and to work in rural NL than MMG FP who did not do residency training at MUN.

We also found that 50% of MMG FP who worked in rural communities were from urban backgrounds, which is consistent with previous findings that 34-67% of rural communities had FP with urban upbringings.[40]

Contrary to our hypothesis, we did not find that having a "gap" between completing residency and starting work in NL was associated with working in NL or rural NL.

We also found that FP who worked in NL and in rural NL moved within the province. Previous studies of NL physicians found that incentives such as RFS agreements keep physicians in rural communities longer,[54,78,83,84] while some suggest it had no effect on physicians working in rural/remote communities[85] and some that have found financial incentives have little importance on recruitment factors and none on retention factors.[81,86]

5.1.2 Retention in NL

Ninety-seven (65.5%) of the 148 MMG FP who began work in NL between 2000 and 2013 practiced in NL for at least 5 years and 77.6% of locations retained a FP for at least 5 years. Forty-nine (57.6%) of the 85 MMG FP who began work in NL between 2000 and 2008 practiced in NL for at least 10 years and 64.1% of locations retained a FP for at least 10 years. These findings were higher than previous literature which examined the length of practice in the province with licensing data where roughly 30% of MMG FP remained in NL 5 years after starting practice (roughly 40% when locums are excluded,[18] which examined length of practice in the province with licensing data.

Consistent with our hypothesis, in both analyses, FP who were from NL were less likely to leave NL than FP who were not from NL. Previous literature has reported findings that being from NL was a predictor of family physicians working in NL.[8,18,20]

We found that 22 (55.0%) of 40 FP who began work in a rural community in NL between 2000 and 2013, worked in a rural community for 5 years, and 12 (50%) of the 24 physicians who began work in a rural community in NL between 2000 and 2008 worked 10 years in a rural community. Because of small sample sizes we were unable to identify predictors of working 5 and 10 years in rural community.

5.1.3 Practice Location Results

Our final set of analyses examined retention by location (as opposed to physician), allowing us to examine the relationship between location specific characteristics and length of work in NL. In the analyses for objective 2, a FP could move locations within NL but was still considered to be working in the province. In this set of analyses, we looked at each location a FP worked in a single community.

We found that retention (i.e. not leaving a location) was related to individual FP characteristics: gender and being from NL. Notably, retention was not related to location specific factors such as size (i.e. urban/rural), regional health authority or retention bonuses. This study is the first that we know of to analyze the impact of retention bonus zones in NL on the retention of physicians in NL and in rural NL. While retention bonuses do not appear to influence retention of MUN graduate FP, further research is needed to understand whether retention bonuses influence the retention of international medical graduates, other Canadian medical graduate FP, and of specialists in NL.

5.1.4 Cross-Sectional Predictors not a Predictor in Longitudinal Study

Having a rural background was cited in countless cross-sectional and case-control studies for being a predictor of working in a rural practice location.[4,18,56,57,58,60,61] A study by Chan et al. reported that approximately one-third of new rural physicians come from rural backgrounds[7] and that a physician having a rural background was two to four times more

likely to practice in a rural location[7,11] None of the analyses in this study found that having a rural background was a predictor of working in a rural location. This could be because cross-sectional studies only analyze recruitment factors while this study looked at retention factors (duration of practice). This means that while rural background may be a recruitment factor for working in rural NL, it was not a retention factor for working in rural NL in the long-term (5 and 10 years).

5.1.5 Policy Implications

FP who were originally from NL were more likely to work in NL and remain in the province. These findings support medical school admission policies that favour admission of local students. MUN for example, has 80 seats available for each class of medical graduates during the admissions process. Sixty are reserved for applicants who are from NL (including three for Aboriginal applicants), and with the remaining 20 seats, 14 are allocated to the two other Atlantic provinces (New Brunswick and PEI) and six are reserved for applicants from other Canadian provinces.[62]

Another important policy relevant finding in this study was that retention bonuses (that were introduced to NL to encourage physicians to practice in rural locations and for longer periods of time through higher bonuses) were not associated with location-specific characteristics, which is still debated in the literature.[14] Some studies have found that financial incentives such as RFS agreements keep physicians in rural communities longer,[54,78,83,84] while other studies suggest they have no effect on physicians working in rural/remote communities[85] and some that have found financial incentives have little importance on recruitment factors and none on retention factors.[81,86]

5.2 Strengths/Limitations

5.2.1 Strengths

Previous studies have all been cross-sectional which only allows us to draw conclusions about one point in time. It provides no information on whether a physician remained in one location for years, if they just started practice in that location or if they returned to that location, overestimating the contribution of MMG FP made to the regional physician

supply in NL (causality). Instead of one point in time, a longitudinal study provides information on multiple points in time, which allows us to assess causality to provide a more accurate understanding of MMG FP contribution to the NL physician workforce. Using a longitudinal study design allowed us to analyze both recruitment and retention factors over periods of time, whereas cross-sectional studies have only been able to analyze recruitment factors at one time point in a physician's career. The use of this study design and the nature of the data allows a stronger interpretation of findings, minimizing biases and confounding.

Another strength to this study was the data sources. The two administrative databases used captured almost 100% of MMG FP because they were government records, (limiting selection and response bias) and included information about graduates that are traditionally captured in surveys (limiting recall bias). These datasets also allowed us to separate FP from specialists for our analyses. This was a strength for our study because FP and specialists have different sets of predictors for practicing in NL and in rural NL, about which previous studies did not account. It was important to conduct this research separately for FP.

The use of survival analyses was also a strength for our study. It allowed us to assess the correlation and causation on the predictors of working in NL and in rural NL for periods of time, not just for one year. It allowed us to assess each location in which physicians worked in and for what duration, as opposed to just one location, and it allowed us to analyze many classes of graduates over a long period of time. For example, we were able to analyze the predictors of working in NL and in rural NL for each MMG class from 1997-2014 and allowed for a maximum of an 18-year follow-up and minimum of a 1-year follow-up in the duration of practice. Using survival analyses was essential to being able to analyze the duration of practice MMG FP worked in NL and in rural NL.

5.2.2 Limitations

Despite the strengths of using a longitudinal study design compared to cross-sectional studies designs previously done, there were some limitations to this study. Although the datasets were strong, they were still administrative datasets which did not allow us to

capture information on factors that could be related to working in NL and in rural NL. These factors include high workload, lifestyle factors, family obligations and professional isolation that have been found to be a predictor variables in other studies.[15,16,90,51,52,78] Analyzing these factors are important to advising future policy decision on increasing the physician supply in NL.

Another weakness to our study was that the sample size limited the analyses we could perform when the sample was restricted to rural physicians. Where applicable we have taken measures, as described in the ethics section (Section 3.4), to protect confidentiality to obscure numbers. Our efforts to obscure small cell sizes may make some tables difficult to understand.

The findings of the study may not be generalizable outside NL. It did not include FP working in NL that did not go to MUN, which could provide important information on the recruitment and retention of physicians such as International Medical Graduates and graduates from other Canadian medical schools, and their contribution to the NL physician workforce (ie. Other medical schools and IMG, etc.). This study may however be applicable to other rural areas and medical schools looking to encourage rural practice and analyze their social accountability.

5.3 Future Directions

Areas that should be considered for future studies are using qualitative research to collect individual narratives that would provide insight to further understand the relationship between subjective factors such as high workload, lifestyle factors, family obligations and professional isolation and working in NL and rural NL. Studying these factors over a long period of time could provide valuable information that would lend itself to policy decisions related to recruiting and retaining FP in NL and rural NL.

A future study could also assess the same characteristics in specialists from MUN. Since specialists and FP have a different set of predictors, it would be valuable to understand these different predictors in a longitudinal study such as this.

Another useful future direction would be to continue to obtain data from graduating classes and continually update the datasets used in this study. A future study would then be able to assess predictors of working in NL and in rural NL over longer periods of time. This bigger dataset would also have a much larger sample size, increasing power and allowing us to draw conclusions on results from the duration of time FP practice rurally.

5.4 Conclusion

This study explored the predictors of MMG FP contribution to the physician workforce in NL by assessing predictors of working in NL and rural NL, the duration of practice worked in NL and rural NL and by assessing predictors of 5-and 10-year retention in NL and in a specific location in NL. Our analyses examined 361 MMG FP who graduated from MUN between 1997 and 2014. Just under half (47%) of these FP ever worked in NL and 15% ever worked in rural NL. Of FP who worked in NL, roughly three in five (64.1%) worked in the province for at least 10 years. Half of the FP who practiced in a rural community will remain in a rural community for 10 years. While MUN trained physicians comprise a growing proportion of the overall provincial physician workforce, the majority of MUN graduated FP do not work in NL (or rural NL).

Recruitment and retention of MUN graduates is related to individual physician characteristics and not location specific factors such as retention bonuses. We found that the biggest contributor to working in NL and in rural NL was being from NL. We found that being from NL was a predictor of working in NL and doing at least some residency at MUN was a predictor of working in rural NL. Being from NL was also associated with working in NL for at least 5 years and 10 years respectively. These findings highlight the need to continue policies that build on these factors.

The study contributed to the understanding of the NL physician workforce and the role of MUN medical school in addressing the need for FP in the province. It also supports admissions policies that support local students and shows useful methods for other medical schools to assess their social accountability, as well as other populations with rural areas.

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Appendices

Appendix A: Data Dictionary

Role (inclusion, exclusion, predictor, outcome)	**Data fields from …**	**Variable Category/Description**	**Categories**
Inclusion	[Year of Graduation: 1997 to 2014]	MUN undergraduate graduated from 1997 to 2014	
Inclusion	[Residency at MUN]	Physician must be a family physician	
Inclusion	[Practice Location]	Physician must be practicing in NL	
Exclusion	[Practice Location]	Physician must not be in the military	
Exclusion	[Hometown]	Physician must not be a Malaysian student	
Exclusion	[Work in NL in Each Year]	Physician must be alive (cannot be deceased)	
Outcome	[Practice Location]	First practice location in NL between 2000 and 2013 by town size (10,000 or less, rural)	(0) Urban (1) Rural
Outcome	[Work in NL in Each Year]	Length of work term in NL (years)	(0) No (1) Yes
Outcome	Ever work in NL [yes, no]	Physician ever worked in NL	(0) No (1) Yes
Outcome	Ever work in rural NL [yes, no]	Physician ever worked in rural NL	(0) No (1) Yes
Outcome	Left NL [yes, no]	Physician worked in NL and ever left	(0) No (1) Yes
Outcome	Left community [yes, no]	Physician left community worked	(0) No (1) Yes
Covariate	Gender [male, female]	Physician	(0) Male (1) Female
Covariate	Hometown [urban, rural]	Physician	(0) Urban (1) Rural

Covariate	From NL [yes, no]	Physician	(0) Not from NL (1) From NL
Covariate	Work Outside NL [1, 2, 3, etc.]	Practice Location	Years [1, 2, 3, etc.]
Covariate	Gap [0-2 years, 3+ years]	Time	(0) No gap (0-2 years) (1) Gap (3+ years)
Covariate	Residency at MUN [yes, no]	Education	(0) No (1) Yes
Covariate	Year of Graduation [1997-2005, 2006-2014]	Education	(0) 1997-2005 (1) 2006-2014
Covariate	Work Location # [1, 2, 3, etc.]	Practice Location	Location # [1, 2, 3, etc.]
Covariate	Location Size [urban, rural]	Practice Location	(0) Urban (1) Rural
Covariate	Started in a rural location [yes, no]	Practice Location	(2) No (3) Yes
Covariate	Practice Location [urban, rural]	Practice Location	(0) Rural (1) Urban
Covariate	Retention Bonus Level Zone [0, 1, 2, 3]	Practice Location	(0) Highest Bonus (rural) (1) Medium-high bonus (2) Medium-low bonus (3) Lowest bonus (none)
Covariate	Regional Health Authority [Eastern, Central, Western, Labrador-Grenfell]	Practice Location	(0) Labrador-Grenfell (1) Western (2) Central (3) Eastern

Appendix B: Newfoundland and Labrador Health Research Ethics Board Approval

Research Ethics Office
Suite 200, Eastern Trust Building
95 Bonaventure Avenue
St. John's, NL
A1B 2X5

November 10, 2020

42 Carlinds Drive
Whitby, Ontario
L1R3B9

Dear Ms. Volpe:

Researcher Portal File # 20210928
Reference # 2020.275

RE: The contribution of Memorial University medical graduates to the family physician workforce in Newfoundland and Labrador

Your application was reviewed by a subcommittee under the direction of the HREB and the following decision was rendered:

X	Approval
	Approval subject to changes
	Rejection

Ethics approval is granted for one year effective November 10, 2020. This ethics approval will be reported to the board at the next scheduled HREB meeting.

This is to confirm that the HREB reviewed and approved or acknowledged the following documents (as indicated):

- Data Custodian List, acknowledged
- Research Proposal, approved

Please note the following:

- This ethics approval will lapse on November 10, 2021. It is your responsibility to ensure that the Ethics Renewal form is submitted prior to the renewal date.
- This is your ethics approval only. Organizational approval may also be required. It is your responsibility to seek the necessary organizational approvals.

Appendix C: Western University Health Sciences Research Ethics Board Approval

Western Research

Date: 24 November 2020

To: Dr Maria Mathews

Project ID: 118064

Study Title: The contribution of Memorial University medical graduates to the family physician workforce in Newfoundland and Labrador

Application Type: HSREB Initial Application

Review Type: Delegated

Meeting Date / Full Board Reporting Date: 01/Dec/2020

Date Approval Issued: 24/Nov/2020

REB Approval Expiry Date: 24/Nov/2021

Dear Dr Maria Mathews

The Western University Health Science Research Ethics Board (HSREB) has reviewed and approved the above mentioned study as described in the WREM application form, as of the HSREB Initial Approval Date noted above. This research study is to be conducted by the investigator noted above. All other required institutional approvals must also be obtained prior to the conduct of the study.

Documents Approved:

Document Name	Document Type	Document Date
Thesis Protocol- Research Plan	Protocol	23/Nov/2020
WREM Data Collection Form	Other Data Collection Instruments	23/Nov/2020

Documents Acknowledged:

Document Name	Document Type	Document Date
WREB Referece List	References	13/Nov/2020
Volpe 2020 275 Approval	Other REB approval letter	10/Nov/2020

No deviations from, or changes to, the protocol or WREM application should be initiated without prior written approval of an appropriate amendment from Western HSREB , except when necessary to eliminate immediate hazard(s) to study participants or when the change(s) involves only administrative or logistical aspects of the trial.

REB members involved in the research project do not participate in the review, discussion or decision.

The Western University HSREB operates in compliance with, and is constituted in accordance with, the requirements of the TriCouncil Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2); the International Conference on Harmonisation Good Clinical Practice Consolidated Guideline (ICH GCP); Part C, Division 5 of the Food and Drug Regulations; Part 4 of the Natural Health Products Regulations; Part 3 of the Medical Devices Regulations and the provisions of the Ontario Personal Health Information Protection Act (PHIPA 2004) and its applicable regulations. The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Please do not hesitate to contact us if you have any questions.

Sincerely,

Patricia Sargeant, Ethics Officer (psargean@uwo.ca) on behalf of Dr. Philip Jones, HSREB Vice-Chair

Note: This correspondence includes an electronic signature (validation and approval via an online system that is compliant with all regulations).

Appendix D: Characteristics of family physicians who left rural NL within 5 years

Characteristic	Study Sample (n=40) n (%)	Mean (Standard Deviation)	Left Province: No (n=22)	Left Province: Yes (n=18)	p-value
Gender					0.412
Male	25 (62.5)	4.60 (0.91)	15 (68.2)	18 (55.6)	
Female	15 (37.5)	4.47 (0.83)	7 (31.8)	8 (44.4)	
Hometown classification					0.525
Urban	20 (50.0)	4.45 (0.95)	10 (45.5)	10 (55.6)	
Rural	20 (50.0)	4.65 (0.81)	12 (54.5)	8 (44.4)	
From NL					0.093
No	*<5 (<13.0)*	3.60 (1.34)	*<5 (<22.7)*	*<5 (<28.0)*	
Yes	*<35 (<87.0)*	4.69 (0.72)	*<17 (<77.3)*	*<13 (<72.0)*	
Year of graduation					0.105
1997-2005	21 (52.5)	4.38 (1.07)	9 (40.9)	12 (66.7)	
2006-2011	19 (47.5)	4.74 (0.56)	13 (59.1)	6 (33.3)	
Did at least some residency at MUN					0.832
No	4 (10.0)	4.25 (0.96)	2 (9.10)	2 (11.1)	
Yes	36 (90.0)	4.58 (0.87)	20 (90.9)	16 (88.9)	
Gap					0.204
0-2 years	<35 (<87.5)	4.64 (0.83)	*<17 (77.3)*	*<13 (72.2)*	
3+ years	<5 (12.5)	3.75 (0.96)	*<5 (22.7)*	*<5 (27.8)*	

MUN= Memorial University of Newfoundland; NL= Newfoundland and Labrador
Italicized figures have been modified for security reasons because cell sizes were smaller than 5

Appendix E: Characteristics of family physicians who ever worked in NL based on the first 10 years they spent in NL

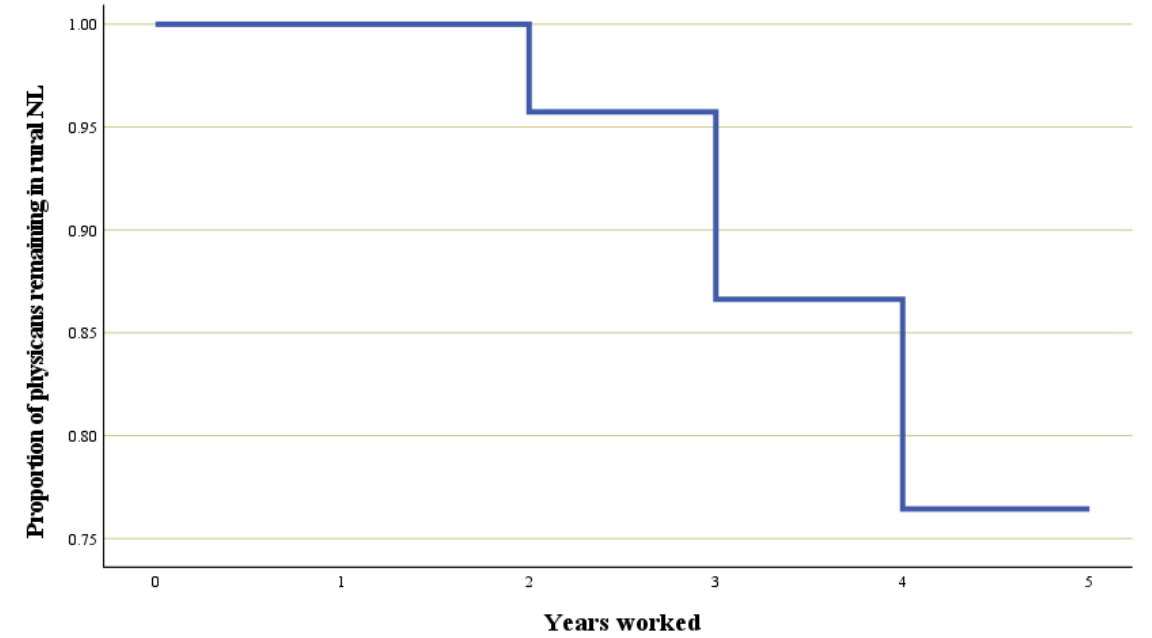
Note: Sample size was too small to allow Cox regression analysis.

Characteristic	Study Sample (n=24) n (%)	Mean (Standard Deviation)	Left Province: No (n=12)	Left Province: Yes (n=12)	p-value
Gender					0.408
Male	14 (58.3)	8.14 (3.26)	8 (66.7)	6 (50.0)	
Female	10 (41.7)	7.20 (3.16)	4 (33.3)	6 (50.0)	
Hometown classification					1.000
Urban	12 (50.0)	7.42 (3.40)	6 (50.0)	6 (50.0)	
Rural	12 (50.0)	8.08 (3.06)	6 (50.0)	6 (50.0)	
From NL					0.064
No	*<5 (<21.0)*	4.00 (2.65)	*<5 (<41.7)*	*<5 (<41.7)*	
Yes	*<19 (79.0)*	8.29 (2.92)	*<7 (<58.3)*	*<7 (<58.3)*	
Year of graduation					0.064
1997-2005	*<19 (<79.0)*	7.43 (3.28)	*<7 (<58.3)*	*<7 (<58.3)*	
2006	*<5 (<21.0)*	10.00 (0.00)	*<5 (<41.7)*	*<5 (<41.7)*	
Did at least some residency at MUN					0.537
No	*<5 (<21.0)*	8.00 (3.46)	*<5 (<41.7)*	*<5 (<41.7)*	
Yes	*<19 (79.0)*	7.71 (3.23)	*<7 (<58.3)*	*<7 (<58.3)*	
Gap					0.140
0-2 years	*<19 (<79.0)*	8.18 (2.95)	*<7 (<58.3)*	*<7 (<58.3)*	
3+years	*<5 (<21.0)*	3.00 (0.00)	*<5 (<41.7)*	*<5 (<41.7)*	
Number of work locations					0.165
1 location	8 (33.3)	5.63 (3.74)	2 (16.7)	6 (50.0)	
2 locations	11 (45.8)	8.55 (2.66)	6 (50.0)	5 (41.7)	
3 and 4 locations	*5 (20.8)*	*18.50 (2.12)*	*4 (33.3)*	*1 (8.30)*	

MUN= Memorial University of Newfoundland

Italicized figures have been modified for security reasons because cell sizes were smaller than 5

Appendix F: Proportion of MMG family physicians who remain in rural NL for the first 5 years of practice



Appendix G: Location characteristics that physicians who leave first rural practice location practice in for a second location

Characteristic	Second community classification no. (%) of family physicians (n=79)		
	Urban (n=55)	Rural (n=24)	p-value
First Community Classification			0.008
Urban	36 (65.5)	8 (33.3)	
Rural	19 (34.5)	16 (66.7)	

Curriculum Vitae

Name: Emily Volpe

Post-secondary Education and Degrees:
Merrimack College
North Andover, Massachusetts, USA
2015-2019 BSc.

Western University
London, Ontario, Canada
2019-2021 MSc.

Honours and Awards:
Western Graduate Research Scholarship
2019-2021

Related Work Experience
Research Assistant
Merrimack College
2018-2019

Research Assistant
Western University
2019- Present

Publications:

Mathews M, Spencer S, Hedden H, Marshall EG, Lukewich J, Buote R, Freeman TR, Gill PS, Liu T, Brown JB, McCracken R, McKay M, Meredith L, Ryan D, Ryan B, Schacter G, Sibbald SL, **Volpe E,** Wickett J, Wong E. Protocol for the Development of a Primary Care Pandemic Plan Informed by In-depth Policy Analysis and Qualitative Case Studies with Family Physicians Across Canada during COVID-19. *Accepted by BMJ Open May 5, 2021*