EMPLOYMENT STATUS AND PROFESSIONAL INTEGRATION OUTCOMES OF IMGS IN ONTARIO

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B.Sc. (Hon.), B.Sc. – Queen's University

Thesis submitted to the Faculty of
Graduate and Postdoctoral Studies
in partial fulfillment of the requirements for
the Master in Science degree in Epidemiology

UNIVERSITY OF OTTAWA

February 2012

ACKNOWLEDGEMENTS

I would like to express my deep gratitude to my supervisors, Professors Ivy L. Bourgeault and Ted Schrecker for their guidance and patience throughout the process of evolution of the thesis. I would also like to thank my statistics advisor, Professor Kathryn Williams, who showed her great support and, helped me through the statistical aspects of the thesis.

The Access Centre for Internationally Educated Health Professionals needs to be thanked for providing me with the database for research. Mr. Wayne Oak and Ms. Jasmine Singh were very supportive and answered all of my questions. Ms. Meaghan Carr-Locke was essential in anonymizing, formatting and sending me a copy of the database and for helping me in understanding the data.

I am extremely grateful for the support and encouragement provided by Émilie, my Parents, my sister Alexandra, and family, friends, colleagues and professors.

ABSTRACT

This study investigates international medical graduates (IMGs), registered between January 1, 2007 and April 14, 2011, at the Access Centre for Internationally Educated Health Professionals in Ontario, which provides advice and resources on the process of seeking professional eligibility to practice medicine or finding alternate training or employment.

The sample included a mix of IMGs at various stages of the medical licensure process in Canada. Some of the characteristics of IMGs (N=8,373) were that they tended to be men, aged 30-39 years who came from South Asia or West Asia, and did not speak English or French as a first language. Most were permanent residents and recent arrivals to Canada (< 5 years); most lived in large cities, with low household incomes and most were unemployed. Most have not taken the Medical Council of Canada evaluating (MCCEE) or the qualifying (MCCQE1) examinations.

In a cross-sectional design, the baseline (at-registration) employment status of IMGs living in Ontario (N=4,558) and its associated factors are investigated using multivariable logistic regression. Baseline employment status includes: full-time or not full-time; full-time, part-time/casual or not employed statuses relating to unlicensed IMGs working in any field. Permanent residents compared to Canadian citizens are half as likely to be in full-time vs. not full-time employment. Other covariates that are significant include: region of origin, gender, time from entry, and age, where effect modification is present by: gender and age, gender and time from entry, age and region of origin, and region of origin and time from entry.

Models for 'full-time vs. not employed' and 'part-time/casual vs. not employed' are also simultaneously estimated via multinomial logistic regression. The longer an IMG has been in Canada, the higher the odds (between two and five times greater) of full-time vs. not employed and part-time/casual vs. not employed status. The effect is more pronounced for part-time/casual vs. not employed. Other covariates that are significant include: citizenship status, region of origin, gender, and age, where there is effect modification as follows: age and citizenship status; and gender and region of origin.

In a cohort design, IMG users' (or those using the services of the Access Centre, N=2,415) time to admission to a residency program (professional integration outcomes in Canada or the US) and their associated factors are investigated by survival analysis methods.

All those that did not obtain residencies by the end of the study period (April 14, 2011) were right censored. Using the Kaplan-Meier method, the median survival time (time to not securing a residency position during the study period) was 51 months with 95% confidence interval of 51 to 60 months after registration. 294 of 2,415 IMG users became professionally integrated (12.2%) and 2,121 did not obtain residencies (87.8%).

Younger IMGs (Under 30 y.o.) had 45% greater hazards of admission to residency than 30-39 y.o. Older age groups had even smaller hazards. IMGs from Africa, Eastern Europe or South Asia all had around half the hazards of admission to residency compared to North American or Western European IMGs. IMGs who have been in Canada 1-5 years had over twice the hazard of admission to residency compared to IMGs who have been in Canada less than one year. The optimal time in Canada (with the highest hazard for admission) is between 5-10 years. IMGs who took the MCCEE also have much greater chances of securing a position in Canada or the United States. In this study, a summary of the conclusions derived and recommendations for future research are presented.

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1.0. BACKGROUND & RATIONALE

This study profiles IMGs registered at the Access Centre for Internationally Educated Health Professionals in Ontario. It is an epidemiologic investigation of the factors that may be associated with IMGs' at-registration baseline employment status (in any field that is not medicine) and professional integration outcomes (or the time from registration to admission to a residency program in Canada or the United States).

There are three parts to this background section: the first provides a historical overview of IMGs in Canada and a description of the Access Centre. The second and third parts state the rationale for this thesis project and its contribution to the field. It is believed that particularly in recent years, IMGs are facing increasing difficulty as they seek the opportunity to work as doctors in Canada. Research in the area of IMGs addresses diverse topics, but there is not very much written specifically about IMGs who are living in Canada, but not yet licensed in a provincial or territorial jurisdiction.

1.1. Historical overview and the Access Centre

In the 1950s and 1960s, Canada's provincial publicly funded universal health insurance systems, commonly known as "Medicare", were developed [(1)]. At the same time, Canada needed doctors for the expansion of health care and attracted many junior doctors from the United Kingdom [(2-3)]. These UK doctors were put on a priority list of occupations, and made up almost half of all IMGs entering Canada [(2-3)].

By the late 1960s, Canada moved away from selecting immigrants mostly from Europe to the creation of a points system, which was supposed to be more open to multiculturalism [(4)]. Between 1954 and 1976, the provinces handed out more licenses to IMGs than to Canadian-trained doctors [(5)]. In fact, "by the mid-1970s many communities, particularly those in [rural] and/or remote regions, were serviced primarily by foreign-trained doctors" [(5) (p.39)]. At the time, IMGs who completed their degrees in English (or French) and were proficient in either language could have their applications 'fast-tracked' and their credentials swiftly recognized according to each province's standards [(6)].

From the mid-1970s onward, concerns over a perceived physician surplus culminated

in having physicians removed from the priority list [6]. At the same time, the process of integration became more difficult and greater numbers of IMGs came from non-English- or non-French-speaking countries [6]. In 1975, "federal and provincial ministers of health agreed to restrict the immigration of foreign-trained doctors to pre-arranged job contracts approved by a province." [5] (p.39)

In the 1980s, if IMGs did not have pre-arranged employment, they were, therefore, ineligible to migrate [5]. These restrictions kept the inflows of both general practitioners and specialist physicians low, fewer than 200 per year[1], between 1980 and 2003 [5]. Also in the 1980s, the earnings and employment potential of immigrants to Canada began to decline, relative to the Canadian-born, which is also known as downward job mobility [7, 8].

Another factor to keep in mind is the release of the Barer-Stoddart report in 1991, which, by assuming a projected physician surplus, catalyzed provincial governments to decrease medical school enrolment by 10% and continue to place restrictions on IMGs, without implementing most of the report's other recommendations, which included: keeping the annual number of funded residency positions to approximate the number of Canadian medical school graduates times the length of residency; and letting non-physician personnel provide necessary clinical services, among many others [2]. If the other recommendations had been followed, especially those regarding task-shifting to nurse practitioners for instance, then the severity of some problems, such as the perceived shortage of physicians, that came up later might have been lessened.

By the late 1990s, the perceived surplus shifted into a perceived shortage of physicians with the College of Family Physicians of Canada reporting more than 4.2 million Canadians not having access to a family doctor in 2004 [2].

The passing of the Immigrant and Refugee Protection Act in 2002 signaled a shift to human capital indicators as the basis for the immigration points system, including points for education, language ability, experience, age, arranged employment and adaptability [4]. Since then and with the launch of Provincial Nominee Programs, it has been easier for IMGs to immigrate to Canada [5]. This has been evidenced by the permanent migration of physicians tripling and temporary migration increasing by 12% between 2002 and 2006 [5]. The most

[1] Statistics from Citizenship and Immigration Canada (CIC) on principal applicants' intended occupation reported by Dumont et al. (2008) [5]

important source countries of IMGs have also shifted from the UK and Ireland in the 1970s to India and South Africa[2] in the 2000s [9]. Nonetheless, there continues to be a lack of internal consistency and coordination, and competing interests between the stakeholders involved at various stages of the immigration and integration process [4].

Recent features of the population of IMGs in Canada have been reported (Census of Canada). In 2001, 90% (92% in 2006) of Canadian-born persons who studied medicine were working as doctors while 55% (56% in 2006) of immigrant internationally educated persons were working as doctors (with 12% working in other health occupations and 33% working in unrelated occupations in 2001) [10, 11]. In 2001, most IMGs lived in Ontario, Quebec, and British Columbia; most earned less than Canadian medical graduates (CMGs), whether they were working as physicians or not; most came from UK/Australia/New Zealand (19.0%), South Asia (11.2%), or Africa[3] (10.1%); and most had Canadian Citizenship [12]. IMGs compared to Canadian Medical Graduates (CMGs), also tended to be older, relatively recent immigrants, and were more likely to live in larger cities (about 50%), be visible minority status (about 50%), to be less likely to speak English or French at home (about 50%), and were more likely to be unemployed (12%) [10, 13]. In addition, the numbers of IMGs as a percentage of the active physician workforce in Canada peaked in 1976 at 33.1% and have declined to a low of 22.4% in 2007 [9].

In Ontario, a new centre that would help IMGs at various stages of the medical licensing process was opened in late December 2006. The centre is known as the Access Centre for Internationally Educated Health Professionals in Ontario. And this study profiles IMGs registered there. The Access Centre is a unit in the Health Force Ontario (the health human resource strategy for Ontario) Marketing and Recruitment Agency. It was and continues to be funded by the Ontario Ministry of Health and Long-Term Care.

It was designed to be a one-stop access point to provide a range of services of internationally trained health professionals, mostly IMGs. Since its creation, it has expanded to most of the health professions regulated in Ontario such as audiologists, dentists, denturists, nurses, and physiotherapists for instance. Services provided by the centre, as are

[2] The Canadian Institute for Health Information (CIHI) obtains statistics from Scott's Medical Data Base (SMDB) reporting only on active physicians in the Canadian workforce who are not residents, serving in the military, retired or semi-retired (CIHI, 2009).

[3] With the exception of South Africa, this was counted separately.

described on its webpage (http://www.healthforceontario.ca/Jobs/AccessCentre.aspx) and include providing the following:

- Information on the standards of professional qualifications and on licensing and registration processes
- Ongoing counseling and support
- Contact information and referrals to the regulatory bodies
- Advice on alternative career options
- On-site reference materials and resources, including an on-site library, referrals to relevant organizations and community resources
- Links to education and assessment programs
- Self-assessment tools
- Information and referrals for retraining and bridge-training programs
- Information sessions focused on various aspects of the registration process

1.2. Rationale for Thesis

There is increasing interest in IMGs in Canada, especially given the perceived physician shortage and lack of access to family doctors. The May 2010 issue of the Canadian peer-reviewed journal *HealthcarePapers* was devoted to 'Internationally Educated Health Professionals: Workforce Integration and Retention'[4]. A 2010 full-length documentary film produced for OMNI.2 Television Network entitled 'The Big Wait' focused on the experiences of three IMGs on their journey to get licensed to practice in Canada[5]. Another 2010 short documentary produced by the National Film Board entitled 'Doctors Without Residency: why can't foreign-trained doctors find work in Canada?' also raised the issues[6]. What is chronicled in research articles and films alike are the hurdles IMGs face, such as financial burdens, being away from family for extended periods, physical and emotional costs, and many years of applying to scarce residency positions for IMGs.

Additional motivation for this thesis project came from different sources: a personal

[4] The special issue of *HealthcarePapers* is available at: http://www.longwoods.com/publications/healthcarepapers/21770
[5] More information on the full-length film is available at: http://www.thebigwait.com/
[6] The short film is available at: http://www.nfb.ca/playlists/work-for-all/viewing/doctors_without_residency/

interest, and the opportunity to contribute to a new but growing body of epidemiologic knowledge about IMGs in Canada. The purpose and scope of this study was therefore to describe a sample of IMGs in Ontario by variables recorded in the Access Centre database and analyze two principal research questions with regards to IMGs registered at the Access Centre.

Baseline employment status, at registration, was assessed in the total population of IMGs registered at the Access Centre. A multivariable logistic regression model was employed to identify factors associated with working in a full-time position vs. not working full-time in any position (given that IMGs are not yet licensed to practice in Canada). A multinomial logistic model with three categories (full-time, part-time/casual, or not employed) was also used to investigate the factors associated with the various employment status categories.

Professional integration outcomes (time to securing a residency position in Canada or the US), after registration, and the factors associated therewith, were assessed in the population of IMGs who were users of the Access Centre's services, Time from registration until either securing a residency position or the study end date were used for the survival analysis.

1.3. Contribution to the field

There are strengths and limitations to exploring research questions related to IMGs in general, their characteristics, employment and professional integration. The strength of this study is that it advances the current state of knowledge regarding IMGs in Ontario, given the lack of data and discussion, in particular, on those IMGs that are unlicensed. This study uses the most recent data available from the Access Centre, and is valuable to examine a sizeable number of IMGs living in Ontario. It includes variables that have not been used in previous studies, it encompasses IMGs who have not yet accessed the medical establishment in Canada and who have recently arrived, and it is useful in seeing which underlying factors may play a role in employment and professional integration. It builds upon diverse literature in the field, and should encourage further study in the area.

This analysis will better inform if IMGs with certain characteristics, who register at

the Access Centre in Ontario have greater chances finding full-time employment before they start using the Access Centre services than others using the cross-sectional component of this study. It will enrich and inform the debate in the literature by bringing current, up-to-date information and analyses on unlicensed IMGs in Ontario. However, there are some limitations that need to be taken into account when making judgments from this study. The database itself contains variables with missing data, redundancies, and all data is self-recorded by IMGs. Any factors found significantly related to employment or professional integration may be important, but a large number of factors are uncontrolled for, since they were not recorded in the Access Centre's database.

Given these strengths and limitations, what this study does is to profile IMGs at the Access Centre as well as answer a few important research questions on IMGs in Ontario, in the most approachable fashion. The results must be taken with caution, but cannot be simply discounted as chance. Further research may point to other important factors, explore the reasons for certain findings, going into more depth – and using different research methods – not excluding qualitative methods. This study will be most relevant to the Access Centre, but also to the broader health human resource policy community. For example, the Association of International Physicians & Surgeons of Ontario or regulatory colleges such as the College of Physicians and Surgeons of Ontario. Since residency training is under provincial jurisdiction, this project is relevant to the province of Ontario, and may not be applicable for other provinces, as they currently do not have similar centres or programs for IMGs.

2.0. REVIEW OF THE LITERATURE ON IMGS IN CANADA

This section provides an overview of the literature on IMGs in Canada. The literature was organized according to the following sections: the process of immigrating to Canada, the process to practice medicine in Canada, quality of care of IMGs, barriers and facilitators to IMG integration, the changing policy environment around IMGs, and key findings of similar studies.

2.1. The process of immigrating to Canada

IMGs immigrate to Canada through various means including: general immigration,

provincial nominee programs or international recruitment. General immigration can take place via economic, family reunification and refugee streams. Skilled workers, the Canadian Experience class, entrepreneurs, self-employed persons, investors, live-in caregivers and provincial/territorial nominees constitute the economic stream [4]. Physicians can also immigrate as spouses/dependents of people in any of those categories.

One class of the economic stream, are the Provincial Nominee Programs (PNPs) wherein provinces 'nominate' individuals, with specific skills, for immigration visas [5]. The immigration process to become a permanent resident takes less time through PNPs than through other immigration categories. And "the province can contact the potential migrants and provide them information and support prior to arrival in regards to recognition of foreign qualifications" [5] (p.43).

IMGs have also been internationally recruited. In this case, the responsibilities for the immigration arrangements of the IMG are handled by a recruitment agency. Regional health authorities (RHAs) from Quebec and Alberta have taken part in job fairs or sent teams to the United States, France, Belgium, UK and the United Arab Emirates [5]. The RHAs claim not to actively recruit, but according to University of Ottawa expert Ron Labonté, "'probably nobody really knows' what Canadian recruiters are doing" quoted in (14) (p.379).

The main reason for recruitment is filling vacancies in specialty (e.g. plastic surgery [15]) or family medicine positions across Canada. Another compelling reason for making use of them is financial: "it is estimated that a single year of medical training for one student at a Canadian institution costs taxpayers close to $170,000" [16] (p. 304).

2.2. The process to practice medicine in Canada

For IMGs, the process to practice medicine in Canada involves six steps: 1) verifying medical degree credentials from an approved university, 2) passing the Medical Council of Canada Evaluating Exam (MCCEE) & providing proof of official language proficiency, 3) completing Canadian postgraduate training by applying through the Canadian Resident Matching Service (CaRMS) or IMG-specific programs, 4) passing the MCC Qualifying Exam parts 1 and 2 (MCCQE1 and 2) to obtain the Licentiate of the Medical Council of Canada (LMCC), which are completed after completion of medical school and after completion of one year of residency training, respectively, 5) passing the College of Family

Physicians of Canada (CFPC) exam or the Royal College of Physicians and Surgeons of Canada (RCPSC) exam and 6) provincial/territorial registration. Each of these licensure requirements is discussed in this section.

1) Credentials verification

To have his or her medical degree source verified, an IMG is required to deposit a copy of his or her medical diploma in the Physician Credentials Registry of Canada (PCRC), a division of the Medical Council of Canada (MCC) and presently pay a $250 fee[7]. The degree is then verified to be true and accurate if it is from an approved institution in the International Medical Education Directory (IMED). If it is not on this list, then IMGs in Canada are forced to pursue an alternative career or work as a doctor in another country.

2) Evaluating examination and language proficiency

To be eligible to enter residency and to write further medical licensing examinations, an IMG must first write the MCCEE either in Canada or abroad. It is a 4-hour computer-based exam, which presently costs $1,550 for first-time test takers and $1,300 for repeat test-takers[8]. Dumont et al. (2008) report that there was only a 65% pass rate of IMGs on this exam in 2006 [(5)]. One reason for this may be that IMGs are not familiar with the structure and format of the exam and that IMGs "do not have the same access to test preparation materials, such as question sets, in the same way as their Canadian counterparts do" [(17) (p.29)]. The Self-Administered Evaluating Examination (SAEE) is a self-assessment preparation tool for IMGs, which addresses part of this problem by providing a sample of the type and style of multiple-choice questions that may be found on the MCCEE. However, IMG professional associations have argued that the MCCEE is a redundant requirement [(18)], which was originally supposed to be a screening exam taken by IMGs abroad. Presently many IMGs only choose to take the exam once in Canada, but many stakeholders are encouraging this to be done prior to arrival.

Moreover, from a practical standpoint, every IMG needs to have knowledge of one of the official languages of Canada, English and French. The importance of medical

[7] Source: PCRC website, *fees* section: http://www.pcrc.org/en/fees.shtml
[8] Source: MCCEE website: http://www.mcc.ca/en/exams/ee/

communication cannot be understated; for instance, Rothman and Cusimano (2000) investigated the quality of ratings of communication skills and oral English proficiency testing in a 1998 Objective Structured Clinical Examination (OSCE) type exam for the Ontario-IMG Program (OIMGP) [19]. Their conclusion was that "standardized patients may be better placed than physician examiners to directly assess candidates' oral English language skills" [19] (p. 766). Both standardized patients and physician examiners continue to be essential to OSCE-type exams, but language proficiency is currently based on scores of other tests. For instance, of those applying to CaRMS in 2002, 92.7% of those who took the Test of English as Foreign Language (TOEFL) passed, whereas 74.6% of those who took the Test of Spoken English (TSE) passed [20].

It may also be beneficial for IMGs to undergo cultural sensitivity training before starting residency according to a pretest-posttest study by Majumdar et al. (1999) with IMGs in the OIMG program in 1996 [21]. The authors found that open-mindedness/flexibility, emotional resilience and perceptual acuity dimensions improved for those who had the training (N=24) compared to those who did not (N=24) [21]. Similarly, Watt et al. (2010) conducted two repeated measures studies (N_1=39 IMGs; N_2=235 IMGs) and showed that participation in a clinically relevant educational program such as M-CAP (Medical Communication Assessment Project) in Alberta can show (statistically significant) improvements in IMGs' language proficiency, communication, and cultural understanding [22]. Finally, Lax et al. (2009) found that Ontario's Communication & Cultural Competence (CCC) Program's web-based scaffolded design supported knowledge building, as defined by participants' needs [23]. The CCC program's scaffolded design included: simulated doctor/patient digital video vignettes, contextualized resources, embedded feedback, and reflective exercises and commentaries [23].

3) Canadian postgraduate training

To be eligible to practice medicine in Canada, IMGs need to have Canadian or equivalent postgraduate training. Currently, the Royal College of Physicians and Surgeons of Canada (RCPSC) has a list of 29 postgraduate training jurisdictions deemed equivalent (which includes colleges in Australia, New Zealand, Hong Kong, Singapore, South Africa, Switzerland, United Kingdom, and Ireland) but IMGs still need to be individually assessed

by the RCPSC before having their training credited[9]. Nonetheless, most IMGs immigrating to Canada have not completed specialist training in one of those jurisdictions and need to apply to the Canadian Resident Matching Service[10] (CaRMS) or to province-specific IMG programs for entry into postgraduate training.

CaRMS uses a computer algorithm that matches candidates to positions, and allows program directors a way to decide which applicants to interview. According to the 2011 CaRMS website, all provinces[11] participate in the matching process, which is run in two iterations. In the first iteration, applicants compete against each other in two separate streams, one for CMGs and another for IMGs (which was started in 2006). In the 2nd iteration, CMGs and IMGs compete against each other in a pooled stream, but the rules about who can apply when have changed over the years.

The CaRMS match results from the first and second iterations for IMGs illustrate increasing IMG participation (*Table 1*). On average, in the first iteration, 20% of IMGs were matching each year (2007-2011), while in the second iteration, on average, 11% of IMGs were matching each year (1995-2011). In absolute terms, greater numbers of IMGs are being matched each year, but since a greater number of IMGs are participating, the percent matching have decreased in the last three years in the second iteration.

Nonetheless, "even with the inclusion of international medical graduates… into the CaRMS process, there were 121 unfilled residency spots in Canada (mainly in Quebec) at the end of the second CaRMS match in 2008" [(24) (p.2)]. This showcases the fact that the final decision on enrolment in residency positions is still at the discretion of program directors. There is also no clear national strategy for discussing the number and mix of residency positions available to medical students [(24)].

After IMGs are matched through CaRMS, program directors decide which candidates to interview. Hofmeister et al. (2009) assessed the reliability of the multiple mini-interview (MMI) for selection into family medicine residency programs in Alberta for IMGs (n=71) [(25)]. Doré et al. (2010) did the same for selection into residency programs in obstetrics-

[9] Source: RCPSC website, *Jurisdiction Approved Training* section: http://rcpsc.medical.org/residency/certification/img_page2_e.php

[10] It is important to note that only Canadian citizens or permanent residents can apply to CaRMS, so that visa trainees apply directly to the postgraduate education office at each university.

[11] Alberta does not participate in the 1st iteration of CaRMS, only the 2nd iteration.

gynecology and pediatrics (McMaster University) and internal medicine (University of Alberta) for CMGs and IMGs (n=484) [26]. Both studies found the MMI to be a reliable[12] way to assess candidates and another study added that it is an acceptable assessment by both IMG applicants (n=71) and interviewers (n=31) [26].

Residency training trends are documented by the Canadian Post-M.D. Education Registry (CAPER), which collects statistics on CMGs, IMGs, and externally funded visa trainees in post-graduate training positions. From 2001-11, the number of regular ministry funded trainees (IMGs) has increased, while the number of non-ministry funded trainees (IMGs) has remained fairly stable (*Table 2*). Over the same period, the number of non-ministry funded trainees (visa trainees) has increased as well (*Table 2*).

Table 1. IMG match results CaRMS 1995-2011[13]

	IMG match results 1st iteration			**IMG match results 2nd iteration**		
Year	IMG participation	Match results	Percentage	IMG participation	Match results	Percentage
2011	1565	298	19.0	1268	82	6.5
2010	1497	274	18.3	1232	106	8.6
2009	1387	294	21.2	1099	98	8.9
2008	1299	305	23.5	929	48	5.2
2007	1486	229	15.4	1125	69	6.1
2006	103	45	43.7	932	111	11.9
2005	-	-	-	629	80	12.7
2004	-	-	-	657	87	13.2
2003	-	-	-	625	67	10.7
2002	-	-	-	496	83	16.7
2001	-	-	-	387	60	15.5
2000	-	-	-	294	39	13.3
1999	-	-	-	231	35	15.2
1998	-	-	-	205	19	9.3
1997	-	-	-	208	16	8.0
1996	-	-	-	236	11	4.6
1995	-	-	-	240	23	9.6

[12] "Three kinds of reliability [were assessed] – internal consistency/interitem, interrater within station…, and interstation." [26] (p. 561)

[13] Source: *Table 1* was collated from information freely available in various tables in the *Reports and Statistics* section of the CaRMS website: http://www.carms.ca/eng/index.shtml

Table 2. Number of percent of IMGs and visa trainees in residency positions, 2001-11[14]

Year	Total # of regular ministry funded trainees (IMGs)	Total # of non-ministry funded trainees (IMGs, excluding fellows)	Total # of non-ministry funded trainees (visa trainees)
2010-11	1711	726	2043
2009-10	1644	777	2131
2008-09	1393	856	2153
2007-08	1258	879	2175
2006-07	1065	919	2078
2005-06	915	929	2041
2004-05	775	923	1926
2003-04	591	899	1797
2002-03	487	869	1621
2001-02	369	759	1510

Over the same period, the percent of first year trainees and practice-ready trainees (exiting residency) who were IMGs generally increased from 2001-11 (*Table 3*).

Table 3. Percent of total trainees and practice-ready trainees who were IMGs, 2001-11[15]

Year	% of total 1st year trainees (IMGs)	% of total trainees exiting (IMGs)
2010-11	15	21
2009-10	17	18
2008-09	17	17
2007-08	17	17
2006-07	16	18
2005-06	13	15
2004-05	15	15
2003-04	10	11
2002-03	12	8
2001-02	9	6

A survey was sent in 2005-06, to all IMGs enrolled in residency programs (n=87, response rate=74%) and program directors (n=45, response rate=62%) at the University of Toronto [(27)]. IMGs and program directors had different opinions about IMGs challenges, but agreed about having orientation programs for IMGs [(27)]. This begs the question about the

[14] Source: *Table 2* was produced from information freely available in various tables in the *Publications* section of the CAPER website: http://www.caper.ca/index_en.php
[15] *Ibid*.

barriers and facilitators to IMGs' professional integration. In addition, a study using focus groups and one-on-one interviews was conducted at the University of Calgary with 2nd-year family medicine residents (N=17, of which 7 were IMGs) enrolled in 2004 [28]. The IMGs wanted to work in practices upon completion, compared to CMGs who wanted to first work in locums; this may be due to having already worked as doctors and being more confident in their clinical skills and experience [28].

Externally funded IMGs (visa trainees) at the University of Ottawa undergo the Pre-entry Assessment Program (PEAP) before beginning residency. Hall et al. (2004) conducted focus groups/interviews (n=4) and sent surveys to IMGs (n=12) participating in PEAP [29]. They found that there was a need to assess communication skills and provide support [29]. A similar program for non-visa trainees who are IMGs does not exist at the University of Ottawa.

IMGs may also apply to a limited number of IMG-specific residency programs, with a different selection method than CaRMS (*Table 4*). Currently, only British Columbia and Alberta have such programs, while other provinces have IMG positions available in a parallel stream in the 1st iteration with additional positions available in the 2nd iteration of CaRMS. In Quebec, IMGs also need to obtain the Recognition of Equivalence of Doctor in Medicine Diplomas allowing them to apply to residency. In BC, between 1992 and 1999, the selection process allowed for only 2-3 residency positions per year for IMGs [30]. This increased to 19 positions in 2010 (*Table 4*).

Table 4. List of current IMG-specific residency programs

Province/territory	Program	Number of positions for IMGs in 2010
British Columbia	IMG-BC	Family practice: 13, Specialty medicine: 6
Alberta	AIMG Program	Family practice: 10, Specialty medicine: 11
Ontario	IMG-Ontario	Ceased operations in 2006; residency positions only available through CaRMS

4) Qualifying examinations

CMGs and IMGs need to write the MCC qualifying exams parts 1 and 2 to obtain the

LMCC[16], one of the steps towards full licensure. The MCCQE1 presently costs $780 and is a one-day (7.5 h) computer-based test including 196 multiple-choice questions and short-menu and short-answer questions[17]. The MCCQE2 presently costs $1,950 and is an objective structured clinical examination (OSCE) consisting of 5- and 10-minute clinical stations[18].

Of those IMGs, who applied to the 2nd iteration CaRMS match in 2002, and subsequently took the MCCQE1, 89.4% passed and of those who took the MCCQE2, 60.5% passed (20). Dumont et al. (2008) also reported pass rates for IMGs of 70% on the MCCQE1 and 75% on the MCCQE2 in 2006 (5). Canadian Medical Graduates pass rates on these exams are much higher. In addition, Eva et al. (2010) investigated the extent to which use of formal medical terminology influences the test performance of candidates writing the MCCQE1 (n=3299) by altering the language of 6 clinical cases (31). Their experiment revealed "the influence of medical terminology is driven more by the strength of candidates' individual medical knowledge bases than by their general abilities in English or French" (31) (p.783). This implies that the MCCQE exams may really be testing medical knowledge and do not unduly disadvantage IMGs as a result of language nuances.

The advantage of the exam process is that it has been around for nearly a century in Canada and the US and is…

> …a multi-competency assessment that focuses learner and teacher behaviour on the range of knowledge, skills and behaviours necessary for effective medical practice (32) (p.214). Scores on the MCCQE exams have been linked to real clinical outcomes (31) (p.782).

On the other hand, the costs borne by some IMGs in the process of licensure are thought to be prohibitive. Sharief and Zakus (2006) interviewed a group of IMGs (n=21), entering the IMG-Ontario program (2002-03), who were fluent in English and had written the MCCEE (33). They found that the median percentage of IMGs' annual income that was spent on resources, such as study time, books, and commuting, was 42% (IQR[19]=21%, 74%) (33).

[16] LMCC: Licentiate of the Medical Council of Canada
[17] Source: MCCQE1 website: http://www.mcc.ca/en/exams/qe1/
[18] Source: MCCQE2 website: http://www.mcc.ca/en/exams/qe2/
[19] IQR: Interquartile range

5) Certification exams

In the final year of a residency program in Canada, all medical residents need to complete certification exams from the RCPSC[20] for medical specialties and from the CFPC[21] for family medicine. Some studies that have shown relatively low pass rates for IMGs on these exams. For instance, McKendry and Dale (1995) examined influence of residency program size on pass rates of certifying exams of the RCPSC between 1985-1990 [(34)]. They found that for smaller programs, the pass rates for IMGs were only 40% compared to 72% for larger programs [(34)].

A more recent study, a retrospective analysis of Quebec IMGs' examination pass rates (2001-08) was undertaken by MacLellan et al. (2010) [(35)]. IMGs' success rates for the pre-residency examinations were below 50%, while they were 56% for certification exams [(35)]. This is compared to a 93.5% pass rate for Canadian or US medical graduates on the certification examination [(35)]. Reasons for IMGs' poorer performance on examinations are unclear. The authors suggest that integration issues, "how and when an IMG learns to translate the knowledge and integrate it with clinical decision making" [(35) (p.917)], and heterogeneous educational backgrounds may somehow contribute to this.

A similar study by Andrew (2010) analyzed the results of in-training evaluation reports and the Certification in Family Medicine examination (CCFP) results (2006-08) at St. Paul's Hospital in Vancouver, BC, to compare IMGs (N=24) with CMGs (N=21) [(36)]. The author found no statistically significant difference between IMGs and CMGs for the in-training evaluation reports for years 1 and 2 of the program, but found that only 58% of IMGs passed the CCFP exam compared with 95% of CMGs [(36)]. He offers some of the same explanations as MacLellan et al. (2010) and adds that IMGs were older than CMGs, many had children, and that the format of the CCFP exam may have disadvantaged them [(36)].

6) Provincial/territorial registration

The end-stage of the licensure process is registration with a provincial or territorial medical regulatory body, such as the CPSO[22], which grants the applicant a Certificate of

[20] RCPSC: Royal College of Physicians and Surgeons of Canada
[21] CFPC: College of Family Physicians of Canada
[22] CPSO: College of Physicians and Surgeons of Ontario

Independent Practice.

The practice patterns of fully licensed IMGs in Canada have previously been examined [9][23, 37]. In 2007, 22.4% of active physicians in Canada were IMGs [9]. Over the course of 10 years since starting practice, IMGs were leaving the country or changing careers at a greater rate than CMGs [9]. Watanabe et al. (2008) used the CMA database and confirmed that many IMGs return to their country of origin or a neighbouring country after spending time in Canada [9]. Between 1995 and 2005, 43% 'returned home'. IMGs were also less likely than CMGs to be practicing the same jurisdiction after 10 years [9].

Over the period 1977-2007, Quebec and PEI had the smallest proportion of IMGs in their physician workforces and Newfoundland and Labrador (NL) and Saskatchewan had the highest [9]. Despite an overall decline in the number of IMGs in the physician workforce across Canada, Nova Scotia, NL, New Brunswick, and the Territories all saw increases in the numbers of new IMGs entering the workforce from 2003-2007 compared to 1972-1976 [9]. IMGs were also more like to work in the city in Ontario and Quebec, while more likely to work in the countryside elsewhere, which was especially true for new doctors (9). In any case, "based on survey data (CFPC et al. 2004), in most respects, IMGs practice in a similar fashion to CMGs, especially once they are well established." [37] (p. e133).

According to NPS[24] data, only 19.3% (± 0.5%) of practicing physicians were IMGs in 2007, which is slightly lower than SMDB data due to different populations [9]. According to the NPS, of the IMGs surveyed in 2007, 72.7% neither grew up in Canada nor obtained their MD degrees in Canada, while 27.3% grew up in Canada, but obtained their MD degree abroad [9]. This speaks to the fact that there are many (and indeed an increasing number of) Canadians who choose to study medicine abroad, especially since they could not obtain a spot in a Canadian medical school.

Several authors have also looked at the experiences of fully licensed IMGs in the Canadian workforce. Joudrey and Robson (2010) conducted a study of the pre- and post-migration experiences of South African-trained IMGs (N=73) [38]. South African physicians

[23] The Canadian Institute for Health Information (CIHI) obtains statistics from Scott's Medical Data Base (SMDB) reporting only on active physicians in the Canadian workforce who are not residents, serving in the military, retired or semi-retired. IMG data reported is only available for those who have become integrated into the physician workforce.

[24] SMDB data does not allow for distinction between an IMG who grew up in Canada and one who grew up abroad, while the National Physician Survey (NPS) data does.

practicing in Canada had more satisfaction working in Canada than in South Africa [38]. Curran et al. (2008) conducted a survey of new IMGs in NL (13 GPs/FPs and 6 specialists) and 4 administrators [39]. They found that there was a need for mentoring, effective integration, and orientation opportunities for new IMGs [39]. In Southwestern Ontario, Thind et al. (2007) conducted a cross-sectional analysis from a 2004 census of family physicians (N=685), out of which 15.3% were IMGs [40]. This group of IMGs tended to be older and in practice longer; worked longer in their current locations; and to be in solo practice accepting new patients; but be less likely to provide maternity and newborn care [40].

Most provinces and territories also allow IMGs to register through provisional licenses or special registers, if they have previously completed residency training abroad and have worked for a number of years (*Table 5*).

Audas et al. (2005) further documents the percent of provisionally licensed IMGs (PLIMGs) and fully licensed IMGs of the total physician workforce in each province in 2003 [41]. For example, NL and PEI have more PLIMGs than fully licensed IMGs; Saskatchewan and NL are the two provinces that rely on IMGs the most; and Ontario, Quebec and New Brunswick have low numbers of fully licensed IMGs and almost no PLIMGs [41]. NL is also thought of an entry point for IMGs who work through their contracts and then move on to, mostly, Ontario and Nova Scotia, or to the United States [42].

An example of a pilot program for IMGs was the Western Alliance for Assessment of International Physicians (WAAIP), which included the Western provinces and Northern territories, in 2005-06 [43]. 25 out of 39 (or 64%) IMGs taking part in this pilot project passed step A (multiple choice exam & OSCE[25]) and 16 out of 25 (or 64%) passed step B (3-month clinical practice) and were granted restricted licenses to practice [43].

A similar program described by Maudsley (2008) is the Clinical Assessment for Practice Program (CAPP) in Nova Scotia, designed to assess the IMGs entering family practice [44]. The CAPP gives IMGs a defined license to work under supervision, and gives them time to obtain the LMCC and CFPC certification to be granted a full license [44]. During the CAPP process multi-source feedback is employed to monitor IMGs. Previously Lockyer et al. (2006) showed that such instruments are reliable using Cronbach's alpha and generalizability coefficient analyses (with N=37 provisionally-licensed IMGs from two

[25] OSCE: Observed Structured Clinical Examination

provinces) [45]. As of 2008, "148 IMGs have been assessed, 35 have been deemed eligible for a defined license, and 27 have entered family practice, virtually all in small or medium-sized communities in Nova Scotia" [44] (p.309). This small success rate of IMGs through the CAPP as well as the WAAIP programs may suggest that many IMGs going through them were not ready to enter (family) practice on a defined license, or did not have enough time to complete the LMCC and CFPC certifications to be granted a full license. It may also suggest a lower quality of their medical education.

The learning experiences of PLIMGs in Alberta have been described by Lockyer et al. (2007) who interviewed a sample (N=19) in 2006 and found that PLIMGs learn and adapt to different patient expectations and that orientation programs and supportive colleagues may help PLIMGs transition [46]. Klein et al. (2009) also interviewed PLIMGs in Alberta in 2006 (N=19), and identified factors that pushed them to leave their countries of origin, factors that pulled them to Canada, and factors that encouraged them to stay or to 'plant' [47]. Finally, Lockyer et al. (2010) conducted focus groups with PLIMGs in six centres in Alberta (N=25) and face-to-face interviews with medical leaders (N=10) [48]. In this case, the interviewers asked about learning needs and approaches. Both PLIMGs and medical leaders came up with similar lists of learning needs, but disagreed on the approaches to follow [48].

Matthews et al. (2007) conducted a physician retention study, which linked the Memorial University of Newfoundland postgraduate database (doctors who began residency by 1998) with the 2004 Scott's Medical Database to determine work locations of physicians [49]. From the data, PLIMGs and CMGs were equally less likely to work in NL (or Canada) compared to Medical University of Newfoundland medical graduates [49]. The same authors followed up with a historical cohort study (a summary is available by Basky et al. 2007) using Cox regression methods to examine the same three groups of physicians who began practice in NL in the period 1997-2000 to see where they were practicing in 2004 [50]. CMGs and IMGs were more likely to leave NL than Medical University of Newfoundland medical graduates [51] (p. E37).

Table 5. Provisional licensure for IMGs[26]

Province/territory	Special assessment programs for provisional licensure	Provisional licensure types
British Columbia	Pre-screening assessment, Provisional licensure process	-Temporary
Alberta	Pre-screening process, Special register process	-Special registers 1-5
Saskatchewan	Provisional, conditional or special licensure process	-Provisional -Conditional -Special licenses
Manitoba[27]	Assessment program (IMGACL) & Training program (MLPIMG) for family practice, Assessment program (NRSAP) for specialists	-Temporary -Conditional
Ontario	Assessments through Centre for the evaluation of health professionals educated abroad (CEHPEA)	-Restricted Certificate -Repatriation -Registration through Practice Assessment (RPA)
Quebec	Assessment through College des Médecins du Québec (CMQ)	-Restrictive permit
New Brunswick	Assessment through CPSNB[28]	-Public Service License
Nova Scotia	Clinical Assessment for Practice Program (CAPP) for family practice	-Temporary License -Defined License
Newfoundland and Labrador	Clinical Skills Assessment and Training (CSAT) program for general practice	-Provisional -Temporary
Prince Edward Island	Assessment through CPSPEI[29]	-Temporary -Limited

Audas et al. (2009) developed a database of PLIMGs who practiced in NL between 1995 and 2004; migration patterns within Canada were tracked until 2006 (from the Canadian Medical Directories) (42). The results indicated that many PLIMGs leave NL after their contractual agreements end (42) (p.23). Cited reasons for leaving include: dissatisfaction with pay and social networks; wanting more social interaction with same cultural background; and social and professional isolation in rural areas (52). This pattern has been confirmed in Saskatchewan, where, out of 39 IMGs tracked in rural practice, 51% had

[26] Source: updated/modified table from Dumont et al. (2008) (5)
[27] IMGACL: IMG assessment for conditional licensure, MLPIMG: medical licensure program for IMGs, NRSAP: non-registered specialist assessment program
[28] CPSNB: College of Physicians and Surgeons of New Brunswick
[29] CPSPEI: College of Physicians and Surgeons of PEI

migrated out of the province within five years [53]. An orientation DVD, guide, and two-day conference were found to be good investments to help with IMG retention [53].

2.3. Quality of care of IMGs

The quality of care provided by IMGs working in Canada with either full or provisional licenses has not received very much attention in the literature. The studies that are available have previously been classified according to structure/process/outcome measures [54]. Examination scores, certification rates and the like fell under structural measures, while guidelines followed or the provision of care were considered process measures. Examples of outcome measures were mortality rates, complication rates, re-hospitalization rates, and malpractice experience, among others [54].

Structural and process studies have been discussed in the context of medical knowledge on the qualifying exams [31], and pre-, during- and post-residency evaluations and certification exams in Quebec [35] and British Columbia [36]. These studies paint an overall negative picture of the quality of care provided by IMGs. In contrast, an older study by Henderson et al. (2001) documented the procedural skills practiced by British Columbia's FPs/GPs [55]. They found that IMGs used "more surgical-type skills than Canadian-trained physicians" [55] (p.185) such as for cesarean sections, laparotomy for ectopic pregnancy, and marsupialization of Bartholin's cysts [55].

Outcome studies have been just as rare as structural/process studies in Canada. Ko et al. (2005) conducted a retrospective cohort study of heart attack or acute myocardial infarction (AMI) patients treated by IMGs and CMGs [56]. 127,275 AMI patients admitted between 1992 and 2000 to Ontario hospitals were included [56]. In this setting, IMGs, coming from 60 different countries, fared just as well as CMGs with regards to risk-adjusted mortality rates and in prescribing therapies, after adjusting for other physician characteristics [56]. IMGs from English-speaking countries fared just as well as those from non-English speaking countries [56]. Nonetheless, the quality of care was based on a single admitting physician, when others may have influenced the care of patients; and the findings may not be generalizable to other areas of medicine or to other jurisdictions [56].

Another retrospective study involving 1,173 patients with active tuberculosis (TB) in

Toronto was conducted using Cox regression to find the risk factors associated with all-cause mortality [57]. The crude hazard rate for the risk factor, 'treating physician, foreign graduate' was 0.78, indicating improved survival; however, the 95% confidence interval indicated non-significance (0.48-1.28) [57]. The conclusion to draw from this study is: whether the treating physician is a CMG or IMG does not positively or negatively affect survival of patients with active TB. Critically examining the quality of care studies in Canada that have taken place, *none* of them linked structural or process measures with outcome measures.

2.4. Barriers and facilitators to IMG integration

It is evident from the Census of Canada data (2001 and 2006) is that many IMGs in fact are not professionally integrated into the active physician workforce [10, 11, 12, and 13]. Stories of doctors working in unrelated occupations (for instance, taxi drivers) have permeated the media and this phenomenon has been labeled "brain waste" [1, 6]. One reason may be that "Canada has had a situation in which governments do one thing, educational institutions do another, and regulatory authorities do a third." [58] [p.23]. There have not been, until recently, more national or provincially coordinated policies to address the integration of IMGs [6].

Reasons for lack of integration into the medical system can be due to general and profession-specific barriers. The immigration points system has been criticized for having limited relevance to specific employment potential or transferability of credentials [59]. Settlement, family and work responsibilities may delay the process, especially for female IMGs who may also experience gender barriers [6]. Throughout the process, IMGs can experience a lack of access to complete and timely information, a lack of preparatory educational courses, long delays, a complicated bureaucratic process, examination costs, and limited financial resources [33, 59]. Language proficiency ethnic/racial barriers and practice differences can also cause difficulty at any stage of the integration process [6]. Profession-specific barriers include: having access to and passing standardized Medical Council of Canada (MCC) examinations and competing for limited residency positions [5, 6].

Experiences of IMGs (n=12), recruited 2003-05, completing the IMG-Ontario residency program (or who had completed a similar program in Canada within the last 5

years) have been documented using a phenomenological approach through interviews with IMGs [60]. The authors found that IMGs go through a "3-phase process of loss, disorientation and adaptation" [60] (p.53). This process has also been earlier documented as the reconstruction of professional identity among immigrant physicians in Canada [61].

Various stakeholders and policymakers at the federal and provincial levels have created several initiatives to facilitate the process of integration such as: "information portals available on the Internet for skilled immigrants to Canada, bridging programs run by provincial governments, [and the] expansion of the number of residency positions accepting IMGs" [6] (p.9). An example of an information portal is Global Experience Ontario or the Access Centre for Internationally Educated Health Professionals. The MCC has also created a Self-Administered Evaluating Examination (SAEE) to familiarize IMGs with the multiple choice exam formats [62]. Since 2002, many new developments at the federal and provincial levels have affected IMGs such as the début of the Foreign Credential Recognition Program (FCR) in 2005, and the opening of the Foreign Credentials Referral Office in 2007. Notably, in 2007, one of the barriers to IMGs was taken away by allowing them to compete in a parallel stream with CMGs in the first iteration of the CaRMS match for the first time.

In order to streamline the assessment and recognition process, the Forum of Labour Market Ministers developed the Pan-Canadian Framework for the Assessment and Recognition of Foreign Qualifications (*Figure 1*) [62]. This framework will come into effect for physicians by 2012, and will complement existing mechanisms with the onus on providing an IMG with an answer (with regards to the suitability of their credentials) after a year's time since their application. The implementation plan also includes: enhancing pre-arrival supports, assessment and recognition, addressing workforce participation needs by introducing, enhancing or expanding supports for immigrant labour market integration; and accountability through public reporting to government [62]. In addition, the CPSO[30] has made policy changes in which the focus has shifted from a credentials review process to a process of assessments and evaluation of individuals to determine their skills and competence [63].

[30] CPSO: College of Physicians and Surgeons of Ontario

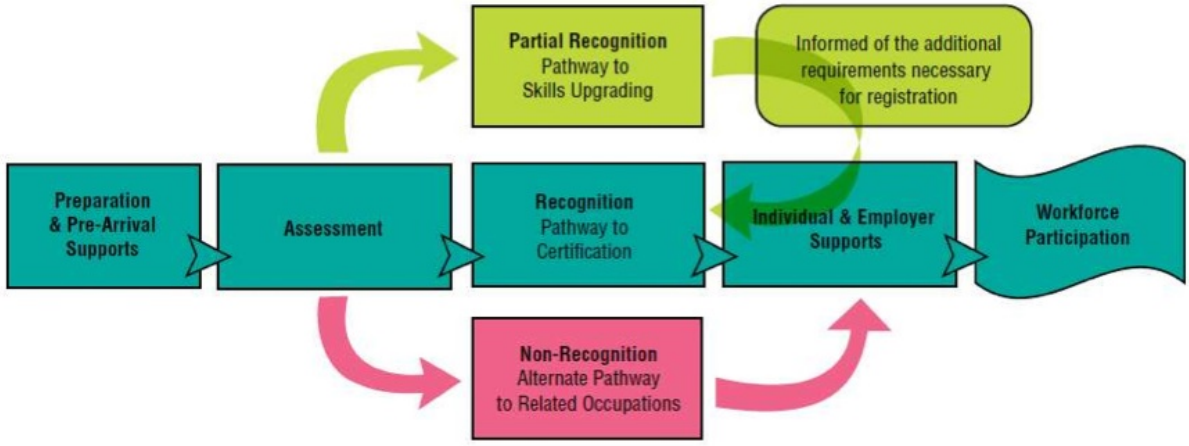

Figure 1. Scope of the Framework as viewed from the eyes of an IMG [31]

Strategies in achieving educational equivalence include more preparation, educational and adaptation courses [(64)]. In Ontario, CEHPEA provides assessment, evaluation, and training programs for IMGs such as the Pre-Residency Training Program or the Orientation to Training and Practice in Canada [(65)]. Bridging and alternative career programs are important for transitioning IMGs to the workplace; these include Catholic Immigration Centre's two-year Medical License Bridging Program or the Career Transitions Program and CEHPEA's Physician Assistant Integration Program (PAIP). University of Toronto's Communication and Cultural Competence Program provide language fluency, medical literacy and cultural competency courses. By medical literacy, the program means written and oral communication skills and not only medical knowledge.

Every year, the number of residency positions for IMGs has been increasing. For instance, before the implementation of the CPSO task force, there were only 24 positions for IMGs and now there are over 200 in Ontario [(63)]. Also, the AFMC's Faculty Development Program for Teachers of IMGs, cultural awareness, a faculty development 'toolbox' and guidelines for site-specific activities available on a user-friendly website [(66)].

In order to increase opportunities for IMGs to register, four new pathways to registration have been set up by the CPSO[32] two of which provide IMGs with transitional

[31] Source: Beardall (2010) [(62)]

[32] CPSO: College of Physicians and Surgeons of Ontario

licenses leading to an independent practice certificate after a year of supervised practice [59]. IMGs who do not have certification by the RCPSC or the CFPC can also apply to the Registration Through Practice Assessment program (RPA), in which experienced physicians can register after an assessment of their existing practice [67].

Health Force Ontario (HFO) is meant to oversee strategies designed to make Ontario the 'employer of choice' [64]. Its Marketing and Recruitment agency has the goal to increase the number of qualified health professionals practicing in the province and its HFOJobs website provides job opportunities for physicians and nurses [64]. The Ontario Physician Locum Programs can provide experience to IMGs in rural areas and the Underserviced Area Program provides physicians wishing to work in rural areas with financial incentives [64].

2.5. The changing policy environment around IMGs

The processes of immigration, licensure, integration, recruitment, and retention occur within a policy environment involving many stakeholders (*Table 6*). These stakeholder communities need to communicate in order to facilitate the process of integration of IMGs into the healthcare system and Canadian society. Federally, there are a number of important changes taking place, which may positively affect IMGs. Medical regulatory bodies are coming into discussions of developing consistent standards for the recognition of IMGs credentials and experience [68].

Apart from the Pan-Canadian Framework for the Assessment and Recognition of Foreign Qualifications, a number of the policy communities are working together on other initiatives. The Agreement on Internal Trade (AIT) allows physicians licensed in one province or territory can migrate to (and practice independently in) another without having to take additional assessments. The Ontario Labour Mobility Act (2009) is part of the provincial implementation of the AIT.

The Federation of Medical Regulatory Authorities of Canada (FMRAC), and the RCPSC and CFPC are also "are actively reviewing current policies on IMG assessment to comply with the… AIT" [68] [p.14]. Yet CMAJ [33] called it a "'moving target' to render competency assessments for IMGs an urgent priority for all regulatory authorities in

[33] CMAJ: Canadian Medical Association Journal

Canada." [68] [p.14]. Nonetheless, the MCC and Health Canada have created a single, nation-wide, clinical assessment of IMGs, the NAC OSCE, which is currently in the process of being implemented [68].

Table 6. List of stakeholder communities

Community	Examples of organizations
Immigration and integration policy community	- Citizenship and Immigration Canada, settlement agencies
Health human resources (HHR) community	- Health Canada, Advisory Committee on Health Delivery and Human Resources
Licensure/regulation community	- Medical Council of Canada, Royal College of Physicians and Surgeons of Canada, College of Family Physicians of Canada, the medical regulatory Colleges in each province/territory
Education community	- Association of Faculties of Medicine of Canada, CaRMS, CAPER
Professional associations	- Canadian Medical Association, Association of International Physicians and Surgeons of Ontario
Employers	- Regional Health Authorities

The FMRAC has also "developed a draft agreement on national standards for medical registration in Canada for both Canadian medical graduates and IMGs." [17] [p.27]. It is supportive of allowing IMGs obtain provisional licensure, and outlines criteria for moving from provisional to full licensure. Once this agreement is ratified, the current approach (in which IMGs and CMGs face different standards and requirements for licensure depending on jurisdiction) would be improved upon [17].

Recent grey literature reports [2, 18, 66, 69-77] and academic publications [1, 59, 78-86] have called on various stakeholders to work together to address Canada's medical workplace issues, while simultaneously helping IMGs integrate in Canada and Ontario in particular. In fact, there "is a general sense, both federally and provincially, that there need be more fast-track options available to integrate more qualified and capable IMGs into the system." [68] [p.23]. The recent Report of the Standing Committee on Health to the House of Commons [17] identified recommendations such as the "Government of Canada [keeping] its 2008 commitment to fund 50 new residencies per year over four year at a cost of $40 million." [17]

(p.34).

To this point, this literature review has highlighted the continuum from immigration to the licensure process to the demographics of IMGs living and working in Canada. It is evident that many stages in this continuum can pose challenges for IMGs, and many authors have stressed the need for orientation and support for IMGs. It is surprising that recently many IMGs in residency training have not done very well on certification exams, while the quality of care provided by licensed IMGs in Canada is similar to that of CMGs. It is also important to note that policy changes that will benefit IMGs in the future are being put into place, for instance with regards to speeding up the process of foreign credentials recognition. Also, up to this point, studies raising the questions about unlicensed IMGs in Canada have not been discussed.

2.6. Key findings of similar studies

Two important similar studies that have answered some questions about the integration of IMGs are: Boyd and Schellenberg (2007 and 2009) and McDonald et al. (2009), which analyzed data from the 2001 Census of Canada [10, 12, and 13]. Two additional studies that describe characteristics of and perceived barriers and supports for IMGs applying to the 2002 match of the CaRMS were: [20] and [87].

Boyd and Schellenberg's analysis (2007 and 2009) had the goal of documenting the extent to which IMGs (N=32,395) were not employed in their profession in Canada [10, 13]. They used multinomial regression models to examine the (log) likelihood of Canadian employment as physicians, adjusting for the effects of sex composition, age, place of residence, visible minority status, language spoken at home, type of degree, years of university education, and sub-field of study. The authors found that the most significant predictor of working as a physician was *birthplace*, followed by *period of arrival* [10]. Canadian Medical Graduates (CMGs) were found to have a 92% predicted probability of working as a doctor, while IMGs born in Africa or South Asia had 85% and 87% chances, respectively, but those IMGs born in other parts of Asia or Eastern Europe had the lowest hypothetical chance (less than 67%), taking all other factors into account [10]. Also, IMGs arriving in the early 1980s had 86% chance of working as a doctor, but only 67% chance if they came in the early 1990s [13].

McDonald et al. (2009) corroborated Boyd and Schellenberg's (2007 and 2009) findings by likewise creating a logistic regression model to examine the (log) likelihood of Canadian employment as physicians of IMGs (N=13,049) adjusting for sex composition, age, age squared, place of residence, urban/rural status, immigration status, period of arrival, region of birth, location of medical education, and language spoken at home [12]. The odds of working as doctor were significantly increased for those born in South Africa: OR=6.89, 95% CI=3.52, 13.49, and significantly decreased for those born in the Philippines: OR=0.41, 95% CI=0.23, 0.74 or in less developed countries in East Asia: OR=0.54, 95% CI=0.34, 0.85, compared to IMGs born in the US (reference category) [12]. All other regions of birth were not significant. Earlier arrival cohorts had greater odds of working as a doctor than later arrival cohorts compared to 1982-86 (reference category) [12]. For instance, IMGs arriving between 1967-71 has almost twice the odds of working as a physician (OR=1.942, 95% CI=1.34, 2.82) as those arriving between 1982-86, however, IMGs arriving between 1997-01 had only one-eighth times the odds of working as a physician as those arriving between 1982-86 (OR=0.12, 95% CI=0.081, 0.175) [12].

In addition, McDonald et al. (2009) took into account the location of medical education and found this factor not to be a significant predictor of working as a doctor [12]. They also found that IMGs who were temporary residents[34] (OR=0.24, 95% CI=0.15, 0.40), female (OR=0.71, 95% CI=0.56, 0.91), or female temporary residents (0.44, 95% CI=0.26, 0.74) all had lower odds of working as a doctor than Canadian-born physicians [12]. They found that language spoken at home (not English or French) was also a significant predictor (OR=0.51, 95% CI=0.43, 0.61) [12].

Finally, McDonald et al. (2009) created a multinomial regression model to examine the risk ratios of Canadian employment in occupations that are: highly skilled, moderately skilled, less skilled and trades, and no occupation/ unemployed/ not in the labour force, compared to working as a physician/specialist (reference category) [12]. They adjusted for sex composition, age, age squared, place of residence, urban/rural status, immigration status, period of arrival, region of birth, location of medical education, and language spoken at home [12]. They found, among other things, that IMGs who are *temporary female residents* have

[34] The Census includes persons living in Canada on a temporary resident permit, study permit, or work permit. Temporary residents are in Canada only for a limited period of stay. However, they can apply for permanent residency at no extra cost at the end of their stay.

almost three times the risk of not being employed (RR=2.76, p=0), while IMGs who are women have almost one and a half times the risk of working in moderately skilled occupations (RR=1.44, p=0.01) [12].

Boyd and Schellenberg's (2007 and 2009) study lacked a separate category for Canadians who studied medicine abroad, and lacked a distinction between full-time or part-time employment, as well as whether IMGs were working in a professional or non-professional occupation [10, 13]. McDonald et al. (2009)'s study did not distinguish between the health sector and other sectors or between full-time and part-time employment, but they did acknowledge "it is not possible to distinguish arrival cohort differences from the effects of duration in Canada in a single cross sectional data set" [12] (p. 17). There have also not been any studies since then that have examined employment status or professional integration of unlicensed IMGs.

In addition, Crutcher et al. (2003) investigated the characteristics of IMGs applying to the 2nd iteration CaRMS match in 2002 (n=463, response rate=70.3%) [20]. They found that most IMGs obtained their degrees in Asia, the Middle East or Eastern Europe [20]. Findings showed that over one-third had graduated since 1994; most were between 30-44 years of age; slightly over half completed their degree in English; almost 70% had completed postgraduate training outside of Canada; almost half had practiced medicine for 6-20 years; and almost half indicated their top choice was family medicine (90).

Also assessing the 2nd iteration of the 2002 CaRMS match, Szafran et al. (2005) conducted a comparative analysis of Canadian IMGs and immigrant IMGs seeking residency in Canada (n=446 respondents, response rate=70%) [87]. Immigrant IMGs were those who immigrated to Canada with medical degrees, while Canadian IMGs were Canadian citizens, landed immigrants or permanent residents who left Canada to obtain a medical degree abroad [87]. Immigrant IMGs, in comparison to Canadian IMGs, tended to be older, married, and have dependent children. They also were less likely to have obtained their degrees recently or completed their MD degrees in English and on average, have spent more years in clinical practice [87]. Perceived barriers and supports were investigated, and organized by assessment, training, practice and supports.

Limitations of Crutcher et al. (2003) and Szafran et al. (2005)'s studies arise from the reliability of self-reported data and the fact that French-speaking medical schools did not

participate in CaRMS (since Sept. 2005 they are included in the matching process) [20, 87]. Szafran et al. (2005) used chi-square and Fisher's exact tests to compare differences between the two groups (Canadian and immigrant IMGs), but did not investigate the relative importance of factors within groups or overall [87].

The previous similar studies discussed described IMGs by a number of variables, and showcased associations between some of those variables and working as a doctor. The current study describes IMGs by similar or analogous variables, and uses more recent data (2007-2011) than the 2001 Census. It also fills gaps regarding knowledge about the employment status of unlicensed IMGs, as well as the factors associated with securing a residency position or professional integration. This step has been described as the most difficult aspect of the integration process due to the scarcity of positions for IMGs [5]. Securing a residency position, or being employed as a physician, is indicative of an IMG integrating into his or her profession as a medical doctor in Canada. Being employed in a full-time position is indicative of an IMG being able to find a more stable employment position as opposed to working part-time casually or not being employed at all.

3.0. THESIS OBJECTIVES

There were two objectives for this thesis:

① To describe a sample of IMGs by variables recorded in the Access Centre database.

② To analyze two principal research questions with regards to IMGs registered at the Access Centre:

i. What are the factors associated with IMG baseline employment status (at registration)? As defined by:

- *Baseline employment status*: working full-time or not full-time; working full-time, part-time, casually, or not employed in any occupation for unlicensed IMGs

ii. What are the factors associated with IMG professional integration outcomes (post-registration)? As defined by:

- *Professional integration outcomes*: time from registration until obtaining a residency position in Canada or the United States of America

4.0. METHODOLOGY & DATA ANALYSES

4.1. Overview

This thesis was a study of the baseline employment status and professional integration outcomes of IMGs who registered at the Access Centre in Ontario between January 1, 2007 and April 14, 2011. According to the Access Centre, a great proportion of all IMGs residing in Ontario have contacted the centre, as well as others residing in other provinces and outside of the country. The exact number of IMGs residing in Ontario, however, is not known. This study had two components: a descriptive component and the ascertainment of associations between covariates and employment status and professional integration outcomes, respectively.

The descriptive component built upon earlier studies and reports that have described IMGs in Canada. Boyd and Schellenberg (2007 and 2009) and McDonald et al. (2009) described, to a certain extent, the employment status of IMGs in Canada (but based on the 2001 Census, which is now over 10 years old) [10, 12, 13]. Descriptive analyses were conducted on a large administrative dataset from the Access Centre in Ontario. The online registration form was completed by all IMGs who registered at the Access Centre and information collected was all self-reported. Information was then input into the Access Centre's data management system.

Working as a doctor in Canada is the goal of an IMG who comes to Canada and can be called, complete professional integration. Earlier studies by Boyd and Schellenberg (2007 and 2009) and McDonald et al. (2009) have identified the factors associated with employment status in terms of working as a doctor in Canada, or working in occupations of various skill levels. In this study, baseline employment status was described as proportions of IMGs in full-time or not full-time employment or as proportions of IMGs in full-time, part-time/casual or no employment [10, 12, and 13]. Employment status across the covariates of interest was reported and Fisher's exact or chi-square tests of independence were computed.

Whether an IMG secured or did not secure a residency position during the study was described as proportions of IMGs professionally integrated or not. Fisher's exact or chi-square tests of independence were similarly computed. The duration (or time that an IMG spent at the Access Centre) until either securing a residency or not was also examined.

A **cross-sectional design** was used to identify "risk" factors for IMGs (at baseline or the time of registration at the Access Centre) to be in full-time employment (compared to not full-time employment) as well as full-time employment (compared to no employment) and finally, part-time/casual employment (compared to no employment). Potential "risk" factors were identified using multivariable logistic regression. The resulting model reflects the multifactorial nature of employment status (among IMGs registered at the Access Centre in Ontario), controlling for the potential effects of a variety of covariates such as age and gender.

A **cohort design** was used to identify "risk" factors for IMGs to secure residency positions over time, while being in contact with the Access Centre. A survival analysis was used to determine the factors associated with time to professional integration (post-registration). Multivariable Cox regression was a straightforward way to test for associations between time to professional integration and a number of covariates of interest. The resulting model illustrates that certain baseline factors of IMGs may have an impact on securing residency positions over time, controlling for various covariates such as citizenship status and first language spoken.

4.2. Description of the Access Centre database

The Access Centre's database contains information on internationally educated health professionals who have registered as clients. The database contained over 10,000 records, of which 8,373 were IMGs as of April 14, 2011. Registration could only be completed online, whether an IMG would be receiving services in-person, by phone or online. The research focused on all IMGs who have registered at the Access Centre (N=8,373).

The variables included in the analyses include both original variables contained in the database as well as derived variables (*Table 7*). For example, the citizenship status category, 'live-in caregiver' contained very few entries and was collapsed with the 'other' category to simplify analyses. The *age* variable (with only 4.8% missing values) was derived from the *birth date* and *age (range)* variables with 3,879 (46.3%) and 4,112 (49.1%) missing values, respectively. The *time from entry* variable (with only 12.1% missing values) was derived from the *arrival date* and *time in Canada* variables with 4,455 (53.0%) and 4,261 (50.9%) missing values, respectively.

The variables excluded from the analyses were those that had too much missing data or were not applicable (*Table 8*). For instance, the primary stream variable would have been useful to separate those IMGs who wanted to become licensed as MDs with those who wanted to find other training or employment, but there were too many missing records. Some IMGs' motivation for registering at the Centre, despite giving up on medicine, may be that they want sound career advice on alternate career pathways.

Table 7. Variables included in the analyses

Variable/description	Derived variables
Registration variables	
Account (entry number)	
Registration date	
Profession (medicine)	
Status (with the centre)	User indicator, user type, integration (in Canada/US)
Demographic variables	
Citizenship status	Citizenship status (with collapsed categories)
City (of residence)	City type, urban status
Province (of residence)	
Country (of residence)	
Gender	
Age (categorical)	Age (categorical)
Birth date	
Time in Canada	Time from entry
Arrival date	
Country of origin	Region of origin
First language spoken	First language spoken (is official language: English or French)
Socioeconomic variables	
Employment status (full-time, part-time, casual, not employed)	Full-time employment status, Employment status (full-time, part-time/casual, not employed)
Household income	
Number of people in household	
Educational/training variables	
Took MCCEE	
Took MCCQE1	
Took CE1	
Country of education	Region of education
Graduation date (date of completion of medical school)	Time from graduation until registration

Table 8. Variables not included in the analyses

Variable/description	Reason for exclusion
Registration variables	
Primary stream (licensing, employment, education)	Over 75% data missing
Secondary stream (licensing, employment, education, or a combination)	Over 90% data missing; no added value to the research questions
Secondary profession	Over 98% data missing
Tertiary profession (comments for Access Centre staff)	Over 98% data missing; no added value to the research questions
Demographic variables	
Languages spoken	Over 38% data missing; not of direct interest to the research questions
Preferred language of contact/ English or French	No added value despite complete since over 95% of IMGs preferred English
Socioeconomic variables	
Occupation	Over 63% data missing
Sector of employment	Over 40% data missing
National Occupational Classification (NOC) Code	More than 58% missing data
Educational/training variables	
MCCEE date MCCEE score MCCQE1 date MCCQE1 score CE1 date CE1 score	Dates and scores on the MCCEE, MCCQE1 and CE1 examinations could not be included in the models. Many IMGs have not taken them, and of those that have, some did not provide their scores and dates when they took them.
Last date of practice	More than 43% missing data
Number of years experience	More than 42% missing data
Language of medical education	More than 89% missing data
Medical specialty	More than 70% missing data

There were also a number of useful variables that were used in determining inclusion or exclusion criteria for the professional integration outcomes research question (*Table 9*). The status variable was used to determine one of the study outcomes – whether an IMG had obtained a residency position. Whether an IMG found a residency position, alternate employment or training was a voluntary phone call or email from the IMG informing the Access Centre of this event. A table was created for clarification of this variable (*Table 10*).

Table 9. Educational/training variables used for other purposes than the main analyses

Variable/description	Reason/use
School attended Program taken at school Applied for residency CaRMS application year(s) ERAS application year(s) Obtained residency interview Year(s) obtained residency interview Country of post-graduate education School of post-graduate education Program of post-graduate education Graduation date of post-graduate education	- These variables were useful in determining the country of (medical) education if that variable was missing - These variables were useful in determining the program length and residency start date for IMGs who secured residency positions as well as to know if those positions were in Canada or the United States (for the professional integration outcomes research question)

Table 10. Clarification of status variable, updated post-registration

User indicator	User type variable	Access Centre status variable	Definition
Non user	Non user	Inactive	- Client is not using services, and most non-users were designated inactive 6 months after registration if there was no further contact
User	Professional integration	Inactive - in training	- Client is has been matched to a residency training program in Canada/US
		Inactive - registered with college	- Client has become registered with the College of Physicians and Surgeons of Ontario
	Alternate career path	Inactive - alternative employment	- Client has found alternative employment
		Inactive - alternative training	- Client has found alternative training (educational program)
	Current user	Active	- Client is using the Access Centre's services
		Active - no advisor	- Client is using the Access Centre's services, but has not been assigned an advisor yet
	Prospective user	Pending	- Client is being followed up by the Access Centre staff

4.3. Baseline employment status data

Categories of the baseline employment status variable included: full-time, part-time, casual, or not employed. Statistics Canada used similar categories for employment status [88]. Since each IMG registered online at the Access Centre only once, the analysis is at the time of registration or at baseline. The Access Centre provided the self-reported baseline employment status data for research purposes.

For the purposes of confidentiality, the identification of individuals which were included by their surname, given name, or other personal information, were not disclosed as the data were anonymous, containing only an account number (entry) variable, which was a string of letters and/or numbers used by the Access Centre for identification. The database did not include those IMGs who had not registered at the Access Centre. For instance, some IMGs will not have registered at the Access Centre if they were practice-ready and/or integrated and working as physicians prior to 2007. Also, the number of IMGs registering at the centre is increasing over time; IMGs registering at a rate of about 100-200 clients per month.

4.4. Professional integration outcomes data

This thesis examined IMGs professional integration outcomes and potential associated factors at the Access Centre in the province of Ontario between January 1, 2007 and April 14, 2011. The professional integration outcome of IMGs registered at the Access Centre was the time from registration to the professional integration outcome.

In order to determine this outcome variable, one of the Access Centre's variables was used: the "status" variable. It recorded the status with the centre, (including if an IMG secured a residency position or not) and was the only variable to be updated regularly post-registration by staff. Certain examinations, dates and scores may also have been updated post-registration by Access Centre staff, for those IMGs that provided that information.

The country, school, program and date of graduation (completion or expected completion of residency) allowed for the determination of whether an IMG obtained a residency position in Canada or the US and when he or she would start their program (in

some cases, the last CaRMS[35] and/or ERAS[36] application year was also helpful in elucidating the residency start dates). The time from registration to professional integration outcome was the time from the initial event (registration at Access Centre) to the terminal event (the start date of residency training). If the IMG did not obtain a residency position, the time to censoring would be the time from the initial event (registration date) to the time of censoring (the study end date, April 14, 2011).

Both time to professional integration and time to censoring were captured by a duration variable. It was reasonable to assume that users of the Access Centre's services have used some of the services provided by the centre from the date of registration until the terminal event (outcome or censoring), since there has been contact post-registration. Once an IMG user obtained a residency position, he or she almost always reported that information to the Access Centre, indeed, with jubilation. Therefore, there had been some contact with the centre between registration, receiving services, and obtaining a position. In the case of IMGs that are users but have not obtained a residency position, there had been contact with the centre between registration, receiving services, and the study end date, April 14, 2011.

4.5. Objective ① - Descriptions of IMGs by variables in Access Centre database

IMGs who registered at the Access Centre were described by original and derived variables recorded in the dataset. The following table (*Table 11*) lists the variables/factors and the amount of missing information for each variable out of the 8,373 IMGs in the complete dataset. It must be stressed that the later analyses in Objective ② used the variables described, after inclusion/exclusion criteria was applied, thereby decreasing the overall number of entries as well as the % missing. Certain variables with greater % missing values were allowed to have a 'not answered' category. This brings with it some advantages and disadvantages. For instance, creating a not answered category prevents the loss of greater amounts of data and keeps the sample size the same. Yet it creates the impression that this category is different in some way from the others, which may pose problems of interpretation and introduces bias into the results. Alternate methods would be to use listwise deletion, which would assume that missing items are missing at random, or to use diverse imputation

[35] CaRMS: Canadian Resident Matching Service
[36] ERAS: Electronic Residency Application Service

methods. Those that did not answer certain questions in this study were not thought to be missing at random and hence the approach of creating another category for them made sense. Imputation methods are more useful for continuous data, which could use a computer program using the mean and distribution of a variable to impute the missing items. However, all variables were categorical in this analysis and these methods were not used.

Only the original and derived variables that were useful are shown (other variables were excluded, see *Table 8*). Proportions were used to describe the distributions by each variable.

Table 11. Variables describing IMGs in Access Centre database

Variable(s) description(s)	Missing (%)
Registration variables	
Account number (entry)	0
Registration date	0
Profession (medicine)	0
Status (with the centre), user indicator, user type, integration	0
Demographic variables	
Citizenship status (Canadian citizen, permanent resident, temporary resident, other)	399 (4.8)
City (of residence), city type, urban status	318 (3.8)
Province (of residence)	669 (8.0)
Country (of residence)	59 (0.7)
Gender	61 (0.7)
Age	404 (4.8)
Time from entry	1010 (12.1)
Country of origin, region of origin	181 (2.2)
First language spoken, first language spoken (is official language)	1733 (20.7)
Socioeconomic variables	
Employment status, full-time employment status	1954 (23.3)
Household income	2582 (30.8)
Number of people in household	2090 (25.0)
Educational/training variables	
Took MCCEE	0
Took MCCQE1	0
Took CE1	0
Country of education, region of education	120 (1.4)
Time from graduation until registration, graduation date	2723 (32.5)

It must be stressed that those variables, which had significant missing data, were not included in the analyses but only for descriptive purposes. The only two variables, which

ended up in the models were first language spoken (is official language) and time from graduation until registration. They had similar percent missing data across outcome categories. Also, creating another response category the 'not answered' allowed for the determination if they were indeed different from the other response categories.

The *account number (entry)* was a continuous variable recording a unique identifier for each IMG client of the Access Centre. *Registration date* was also a continuous variable for the date of registration of each IMG client. *Profession* was a variable that noted that all clients were medical doctors for this dataset. *Status (with the centre), user indicator, user type,* and *integration* variables were categorical variables describing the state of the IMG at the Access Centre.

Citizenship status was grouped into four categories: Canadian citizen, permanent resident, temporary resident, and other. *City (of residence)* was transformed into two variables, *city type* with four categories: town, small city, medium city, large city and*, urban status*: large city or not large city. *Province* and *Country (of residence)* were variables used in the inclusion/exclusion criteria for each model. *Gender* had men and women categories. *Age* in years, contained four categories: Under 30, 30-39, 40-49 and 50 and over. *Time from entry* contained four categories: Less than 1 year, 1-5 years, 5-10 years, and Over 10 years. *Region of origin* and *region of education* contained the following eight categories: North America, Western Europe, Caribbean C/S America, Africa, East Asia, Eastern Europe, South Asia, Southeast Asia, West Asia, which are identical to those used by Boyd and Schellenberg (2007) with the exception that the 'North America, Northern Europe' category was renamed 'North America, Western Europe' as a better reflection of the localization of countries. The *first language spoken (is official language)* variable had categories: yes (English or French was first language spoken), no and not answered.

The *employment status* variable had three categories: full-time, part-time/casual and not employed*,* and the *full-time employment status* variable had two categories: full-time or not full-time. *Household income* had the following categories: $1-19,999, $20-29,999, $30-39,999, $40-49,999, $50-74,999, $75,000+, and prefer not to answer or not answered. The *number of people in household* had seven categories: one, two, three, four, five, over five, and not answered.

Took MCCEE, Took MCCQE1 and *Took CE1* were all dichotomous variables with

categories: yes and no. Lastly, the *time from graduation until registration* variable had the following seven categories: under 1 year, 1-5 years, 6-10 years, 11-15 years, 16-20 years, 21-25 years and over 25 years.

4.6. Objective ② - Analysis of two principal research questions

The second objective of the thesis was to identify potential factors associated with (i) baseline employment status of unlicensed IMGs (at-registration) and (ii) professional integration outcomes of IMGs who have used the Access Centre's services (post-registration). The potential factors associated with (i) and (ii) were identified using multiple logistic regression and survival analysis methods, respectively, with SAS statistical software.

4.6.1. Baseline employment status

Baseline employment status of IMGs (at-registration) was assessed in three ways. The first was to identify the factors associated with full-time vs. not full-time employment by multivariable logistic regression. The second was to identify the factors associated with full-time vs. no employment and part-time/casual vs. no employment also by logistic regression methods.

4.6.2. Professional integration outcomes

Professional integration outcomes of IMGs (time to securing a residency position) were assessed by a survival analysis. Factors were identified that were associated with professional integration by a Cox Proportional Hazards regression on categorical data.

4.6.3. Potential associated factors

The potential factors assessed in each research question are labeled with a checkmark (*Table 12*). Similar covariates were included in analyses by Boyd and Schellenberg (2007 & 2009), McDonald et al. (2009), and Szafran et al. (2005) [10, 12, 13, and 87]. Socioeconomic variables were not included as potential predictors/confounders for the baseline employment status question since they are thought to sometimes result from rather than predict baseline employment status. For instance, a certain household income results from employment, and not vice versa.

Table 12. Potential predictors and confounders for each research question

Variable/description	Research question: Baseline employment status	Research question: Professional integration outcomes
Demographic		
Citizenship status	✓	✓
City type, urban status	✓	✓
Gender	✓	✓
Age	✓	✓
Time from entry	✓	✓
Region of origin	✓	✓
First language spoken (is official language)	✓	✓
Socioeconomic		
Employment status, full-time employment status		✓
Household income		✓
Number of people in household		✓
Educational/training		
Took MCCEE		✓
Took MCCQE1		✓
Took CE1		✓
Region of education	✓	✓
Time from graduation until registration	✓	✓

4.6.4. Inclusion/exclusion criteria

For the cross-sectional analysis, IMGs *registered* at the Access Centre, who lived in Ontario Canada, with known gender and age information, were included (N=4,558). The ideal population for the research would be all IMGs living in Ontario. However, not all IMGs in Ontario have had the opportunity to get in touch with the Access Centre. Although, according to the centre, a great number of IMGs living in Ontario, whose exact number is unknown, have contacted the centre from the time of its inception in December 2006. One way to evaluate the differences between populations would be to compare the current data with the most recent Census 2011 data, which has not yet been released. For the survival analysis, all IMG *users* of the Access Centre's services, living in Ontario, Canada with known gender and age information, were included (N=2,415). It was not possible to use the

non-users, since they have not used the services of the centre beyond initial registration –no more information is known about them beyond what they provided at the initial time point.

IMGs with unknown gender or age; not living in Canada (based on country of residence, citizenship status, or time from entry variables); and/or not living in Ontario were excluded. Additionally, those with unknown employment status were excluded for that research question. Similarly, those with unknown time to professional integration outcome and/or those who had pending status 0-6 months were excluded (*Table 13*).

Table 13. Inclusion/exclusion criteria

Research question	Target population	Inclusion criteria	Exclusion criteria
Baseline employment status	Entire population of IMG clients IMG users IMG non-users	▪ Known gender and age information ▪ Living in Ontario, Canada	▪ Unknown gender ▪ Not living in Ontario, Canada
Professional integration outcome	IMG users	▪ Known gender and age information ▪ Living in Ontario, Canada	▪ Unknown gender ▪ Not living in Ontario, Canada ▪ Non-users, the majority of whom were designated inactive 6 months after registration if there was no further contact ▪ With prospective user (pending) status between 0 and 6 months post-registration

4.7. Data analyses

The selection of variables was partly based on variables included in the most similar studies [10, 12, 13] (*Table 14*). Visible minority status, and language spoken at home were not recorded in the Access Centre database; however, first language spoken may have approximated other language (spoken at home) to some extent.

One of the questions investigated by these authors was the predicted probability or factors associated with working as a medical doctor in Canada. This question can be thought of as distinct from, but analogous to the question of the factors associated with securing a residency position in Canada or the US (professional integration). Similarly, the question of

the predicted probability or factors associated with working in other health occupations, and all other occupations, as well as the factors associated with working in a particular skill level. This question can be thought of as analogous to the baseline employment status.

Table 14. Analogous variables used in the current and previous analyses

Current analysis **Variable/description**	**Boyd and Schellenberg (2007 & 2009)** (10) (13)	**McDonald et al. (2009)** (12)
Registration		
Profession (medicine)	Type of degree Field of study	
Integration (in Canada/US)	Working as a medical doctor	Working as an MD
Demographic		
Citizenship status		Immigration status
City type, urban status	Place of residence	City, region of residence, urban/rural status
Gender	Sex composition	Sex
Age	Age	Age at arrival, age at arrival squared
Time from entry	Period of arrival	Arrival period
Region of origin	Region of origin	Region of birth
First language spoken (is official language)	Language spoken at home Visible minority status	Other language
Socioeconomic		
Employment status, full-time employment status	Working in other health occupations, or all other occupations	Occupation of employment of MD holders (highly skilled, moderately skilled, less skilled and trades, not employed)
Household income		Earned income[37]
Number of people in household		
Educational/training		
Took MCCEE		
Took MCCQE1		
Took CE1		
Region of education		Region of education
Time from graduation	Years of university	

[37] McDonald et al. (2009) conducted a separate analysis, "OLS regression estimates of Determinants of log earnings conditional on holding a medical degree but not working as a physician", but did not include this various as a determinant of working as an MD.

4.7.1. Details of the baseline employment status models

A multivariable logistic regression was performed to determine the factors associated with IMG baseline employment status at the Access Centre (*Figure 2*).

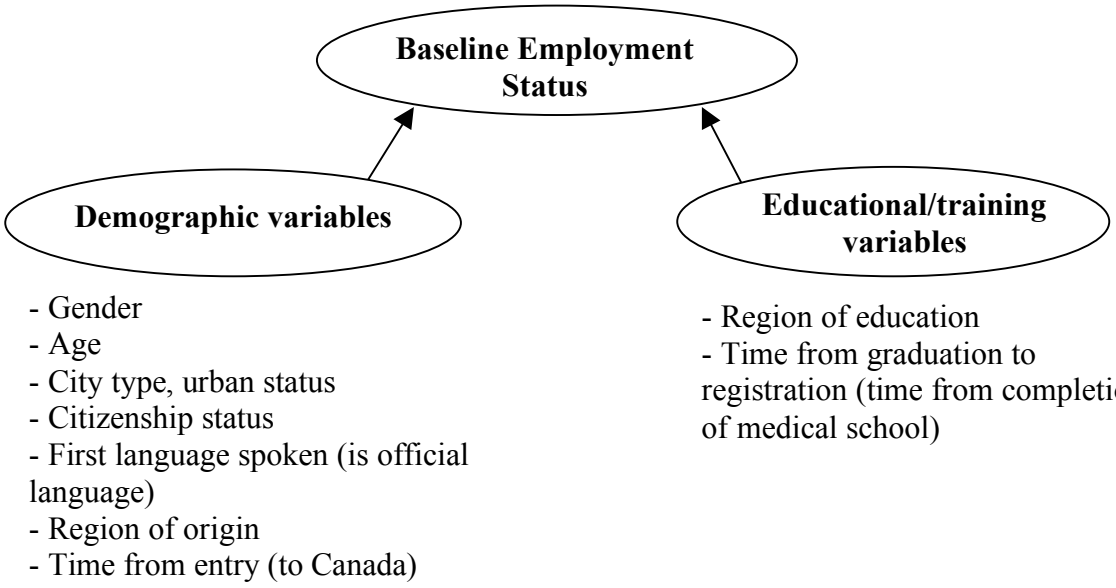

Figure 2. Baseline employment status associated with potential covariates

A diagram of the proportion of IMGs who were employed full-time and not full-time at registration is presented (*Figure 3*).

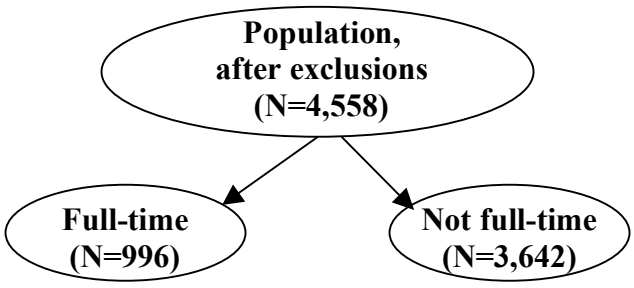

Figure 3. Proportion of IMGs who are employed full-time

The multivariable logistic regression model (1) is used to predict the proportion of IMGs in full-time employment as a function of a number of covariates (x_{ik}):

$$\log[odds] = \log\left[\frac{p_i}{1-p_i}\right] = \beta' x_i$$
$$\text{where } \beta' x_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_3 x_{i3} + ...\beta_k x_{ik}$$
$$\text{and } p_i = \frac{e^{\beta' x_i}}{1+e^{\beta' x_i}} \quad (1)$$

The "odds" represents the ratio of the probability of the occurrence of the outcome (being integrated) to the probability of the outcome not occurring. The probability of the outcome given the current configuration of all the predictors, denoted by $\beta_k x_{ik}$ is given by p_i.

Second, an ordinal logistic regression (proportional odds) model (2) could be used to predict the proportions of IMGs in: full-time vs. part-time, casual or no employment; part-time vs. casual or no employment; and casual vs. no employment. A diagram of the proportion of IMGs by employment status is presented on the next page (*Figure 4*).

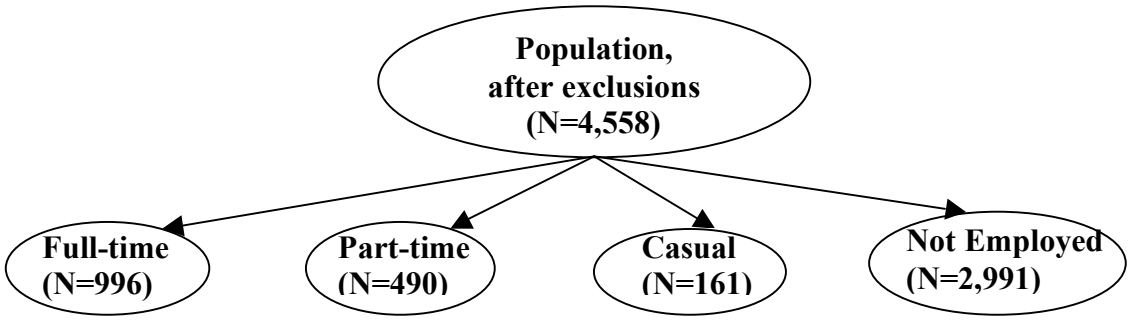

Figure 4. Proportion of IMGs by employment status I

$$\log[odds] = \log\left[\frac{p_i}{1-p_i}\right] = q_j + \beta' x_i$$
$$\text{where } \beta' x_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_3 x_{i3} + ...\beta_k x_{ik}$$
$$\text{and } odds = \frac{p_i}{1-p_i} = \exp(q_j)\exp(\beta' x_i) \quad (2)$$

The odds are interpreted as the odds of a response in category j or below. $Exp(q_j)$ is equal to the baseline odds in category j or below when $x = 0$. The probability of the outcome

given the current configuration of all the predictors, denoted by $\beta_k x_{ik}$ is given by p_i.

In the case of the ordinal logistic regression model, if the proportional odds assumption fails, then a less restrictive multinomial model will be fitted. This would also be partly due to the low numbers of IMGs in the 'casual' employment category. The diagram below shows the proportion of IMGs by employment status when that category is collapsed with the part-time category (*Figure 5*).

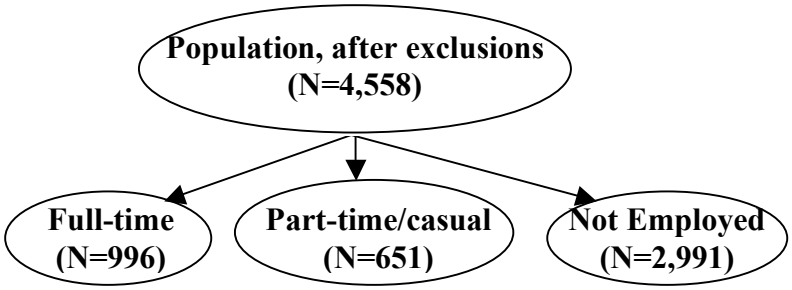

Figure 5. Proportion of IMGs by employment status II

The multinomial model is analogous to the logistic regression model, having the same equation as (2). Except in this case, the dependent variable has three categories (full-time, part-time/casual and not employed) instead of two (full-time, not full-time). Each of these three categories is coded 0 or 1; therefore there are six categories and five dummy variables, and the multinomial logistic regression estimates five separate binary logistic regression models for each of those dummy variables. Each model specifies the effect of certain factors on the probability of 'success' in that category versus the reference category. A multinomial model provides more efficient parameter estimates (coefficients) with less unexplained error than running five separate binary logistic regression models. In this case, only two of the five binary logistic regressions are of interest: 'full-time vs. not employed' and 'part-time/casual vs. not employed'. Interpretation of the odds ratios produced by this model are, for instance, the odds of being full-time vs. not employed for a particular covariate.

4.7.2. Building the baseline employment status models

A multivariable logistic regression was performed to determine the factors associated with IMG baseline employment status at the time of registration at the Access Centre. This

process was to be completed for the entire population of IMG registrants, only users and only non-users in order to make a comparison between these groups. However, a better method was used to see if there was a difference between them. A user indicator variable that was '0' for non-users and '1' for users was created. If it happened to be significant, then separate analyses would be warranted for users, non-users and the entire population of IMG registrants for this research question. If not, then, only a single analysis of all IMG registrants would suffice. Although it was hypothesized initially that employment status could be different between users and non-users, it was in fact not necessary to create a user indicator variable. This was because IMGs would only become users post-registration, while the analysis was at-registration (baseline).

A multivariable logistic regression (full-time vs. not full-time employment status) and an ordinal logistic regression (full-time, part-time, casual, not employed employment status) were originally to be performed. Since there were much fewer IMGs with casual employment status, it was necessary to collapse the part-time and casual employment status categories into a single 'part-time/casual' employment status category. By having only three categories was not necessary to undertake an ordinal logistic regression. A better approach, which did not require the proportional odds assumption as in the case of ordinal logistic regression was to simply perform multinomial logistic regression and compare 'full-time' to 'not employed' and 'part-time/casual' to 'not employed' statuses, respectively. This would be a less restrictive model, not requiring this assumption.

Statistical analyses were conducted using the SAS statistical software package. The frequency measure used was the odds ratio, and showed the strength of the association between covariate and baseline employment status. Descriptive analyses were carried out to determine the prevalence of employment statuses among IMGs registered at the Access Centre, according to a variety of covariates.

Frequencies of each variable level were presented by baseline employment status level (full-time or not full-time and full-time; and full-time, part-time, casual and not employed) and by professional integration outcome level (professionally integrated or not). To see if there were significant differences between each category of each variable by status/outcome level, for categorical variables, a chi-square or Fisher's exact test was performed; for continuous variables, a t-test or Wilcoxon rank-sum test was performed; both

tests gave p-values. The significance level was set at 5% for all p-values. The inclusion of predictors depended on the inclusion/exclusion criteria, the frequency of missing values, the number of outliers, and correlations between variables. If variables of interest have been used in literature or have an entry p-value of less than 0.25, they were included in analyses.

A stepwise selection method helped confirm which variables to include or not to include and a p-value of less than 0.05 was required to stay in the model, unless the covariate was essential (noted in the literature) that was not significant, but had a p-value less than 0.25. Once this was done, the collinearity of main effects was evaluated as it could have caused unstable estimates and could affect confidence intervals and hypothesis tests, especially if there were a large number of covariates.

To determine which factors were associated with each baseline employment status level, a bivariate analysis was conducted. Unadjusted odds ratios (ORs) and their 95% confidence intervals (CI) were calculated. Multivariable analyses evaluating the associations between the main covariates, adjusting for potential confounders and including any significant effect modifiers or interaction terms is performed using logistic regression. Only those factors that change the adjusted-OR by more than 10% are taken into account as confounders with regards to multivariable analyses, with the previously noted exception of literature confounders, as recommended by Rothman et al. (2008).

Afterwards, the goodness-of-fit of the model was assessed using the likelihood ratio test to compare models, the Hosmer-Lemeshow test and the c-statistic. Next, diagnostic checks, such as outlier detection with index plots, were conducted. The outliers' effect on the model was evaluated.

The model was revised, reassessed, taking into account the sample size, substantive motive and to ensure internal validity, the final model's adherence to underlying model assumptions was checked (such as by examining residual plots). Finally, an overall model was fitted. Unadjusted- and Adjusted-Odds Ratios are presented with 95% confidence intervals.

For the ordinal logistic regression only, the proportional odds assumption was tested using a Score test; if this assumption failed, then a less restrictive multinomial logistic regression model was run and the procedure was followed in the same fashion as for the earlier logistic regression model.

4.7.3. Details of the professional integration outcomes model

A survival analysis was conducted to examine the occurrence of professional integration (securing a residency position in Canada or the United States) over time for users of the Access Centre's services. A Cox Proportional Hazards (PH) model was specified. This was possible since time-to-event data were available from the Access Centre dataset. A diagram showing the professional integration outcome associated with a number of potential covariates is shown (*Figure 6*).

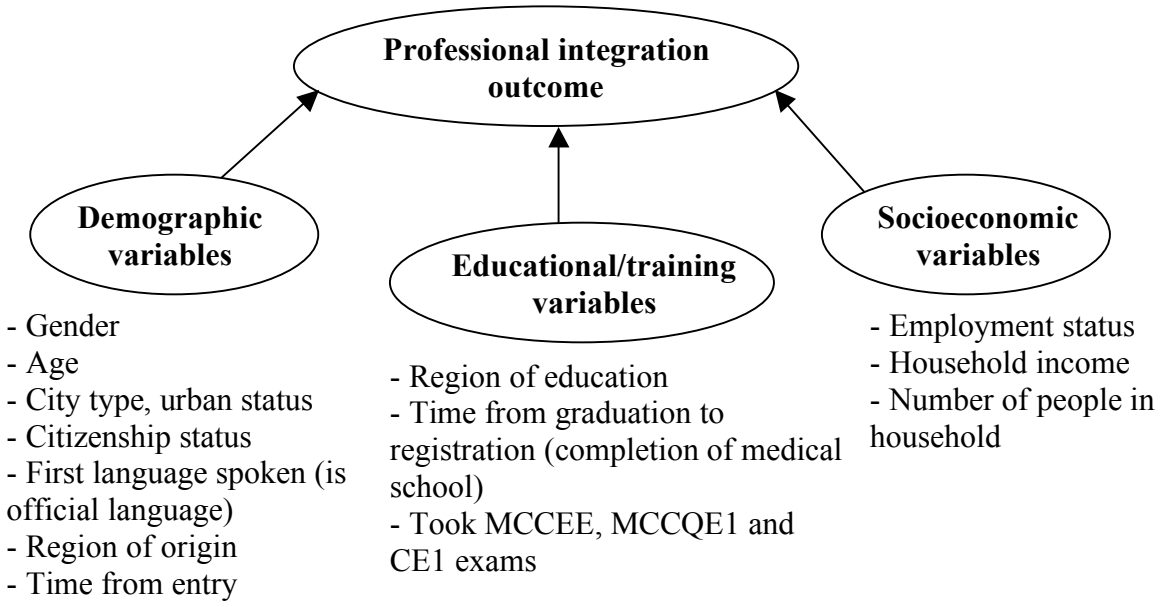

Figure 6. Professional integration outcome associated with potential covariates

The population of IMG users at the Access Centre is investigated for the following professional integration outcome:

- Time to professional integration: time from registration until obtaining a residency position (e.g. postgraduate medical training in Canada or the United States)

A diagram (*Figure 7*) of the proportion of IMGs with and without the outcome is presented:

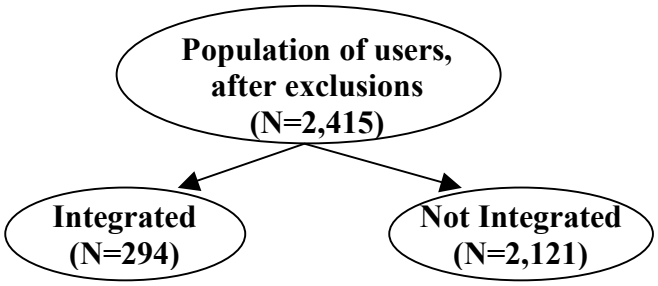

Figure 7. Proportion of IMG users who are integrated

$$h(t_j) = h_0(t)g(x_j)$$
$$h(t_j) = f(t_j)/S(t_j) \text{ where } S(t) = 1 - F(t) \quad (3)$$

$$h(t_j) = h_0(t)e^{(\beta_1 x_{i1} + \ldots + \beta_k x_{ik})}$$
$$\left(\frac{h(t_j)}{h_0(t)}\right) = e^{(\beta_1 x_{i1} + \ldots + \beta_k x_{ik})}$$
$$\ln\left(\frac{h(t_j)}{h_0(t)}\right) = \beta_1 x_{i1} + \ldots + \beta_i x_{ik} \quad (4)$$

The basic proportional hazards model is specified (3) where $h(t_j)$ is the hazard function for a randomly selected individual of the population of users (e.g. the instantaneous conditional probability of professional integration, when he or she has been "at risk" for experiencing this event for at least a period of length t_j). $F(t)$ is the cumulative distribution function of t and $f(t) = F'(t)$, is the probability density of the duration. $S(t)$ is the survival function, which corresponds to the probability that the duration of not becoming professionally integrated (within the study period, from registration for the period of time the IMG accesses the services of the centre) lasts at least a period of length t. It is possible that after the end of the study period, that some IMGs may secure residency positions in the future. The baseline hazard function $h_0(t)$ in (3), assumed identical for all individuals, if left unspecified, results in the Cox PH semi-parametric model. This is an important point to stress – the Cox PH model does not assume an underlying survival distribution or hazard curve, which can take on an increasing or decreasing shape. The function $g(x_j)$ is a non-negative function of covariates, denoted by $\beta_k x_{ik,}$ that affect the event of professional integration. It

can be specified by an exponential function, also written as a relative hazard or a log-relative hazard (4). If a certain variable violates the PH assumption, then it will be included as a time-dependent covariate, which is allowed by the extension of the Cox PH model.

4.7.4. Building the professional integration outcomes model

Statistical analyses were conducted using the SAS software package. The risk measure used in this study was the hazard ratio (HR), which measured the effect of an explanatory variable on the hazard or risk of an event (in this case, of professional integration), taking into account other variables.

The exploration of factors associated with the time elapsed from registration until professional integration was performed using a Cox PH model. First, a Kaplan-Meier plot was used to illustrate the time from time of registration to professional integration for different age groups. Then, a number of Cox PH regression analyses were performed. IMGs users who were not integrated at the time of the study end date (April 14, 2011) were termed 'right censored'. First, univariate relationships between each explanatory variable and professional integration or censoring were examined. Next, several multiple Cox regression models were evaluated in order to identify a final model.

The parsimony and goodness-of-fit of the model was assessed to help select the final model. Diagnostic checks and outliers' effects on the model, and the PH assumption were evaluated. One way to test the PH assumption was to use Martingale residuals[38]; the PH option in the SAS statistical software produces a graphical display of the empirical score process for each variable. If the observed process differed significantly from the simulated process, then there was evidence against the PH assumption. The results for the variables tested were summarized in a table with p-values (those that are significant or under the 5% threshold violated the PH assumption). Another method was to use Schoenfeld residuals[39], in which case they should have been independent of time if the PH assumption was satisfied.

The model was revised, reassessed a number of times, taking into account the sample size, substantive motive and to ensure internal validity, the final model's adherence to

[38] Martingale residuals estimate the difference over time between the observed number of events for the i^{th} IMG client and a conditional expected number of events.
[39] Schoenfeld residuals are residuals for each individual for each covariate and are based on the individual contributions to the derivative of the log partial likelihood; they are undefined for censored individuals.

underlying model assumptions were checked. Finally, an overall model, including all covariates of interest, was fitted. Unadjusted- and Adjusted-Hazard Ratios are presented with 95% confidence intervals.

4.8. Power and sample size calculations

The first research question (baseline employment status) was examined in the whole population of IMG registrants, after exclusions (n~4,500). The gender variable, may be a significant factor in the employment status of MD holders, including IMGs who register at the Access Centre. For instance, McDonald et *al*. (2009) previously studied the occupation of employment of MD holders in Canada (using 2001 Census data) and found females to have greater risk of working in moderately skilled occupations (RR=1.44, p=0.01) or not working (RR=1.61, p<0.01) compared to working as a physician/specialist [12].

To assess the association between a binary dependent variable, baseline employment status (full-time or not full-time), and a binary independent variable, in this case gender, adjusting for other covariates, the sample size formula under the logistic regression model is:

$$N = \frac{\left(z_{1-\alpha/2}\sqrt{\frac{\bar{P}(1-\bar{P})}{R}} + z_{1-\beta}\sqrt{P_0(1-P_0) + \frac{P_1(1-P_1)(1-R)}{R}} \right)^2}{(P_0 - P_1)^2(1-R)} \tag{5}$$

Where P_0 is the event rate at $X_1 = 0$ and P_1 is the event rate at $X_1 = 1$, R is the proportion of the sample with $X_1 = 1$, and $\bar{P}$ is the overall event rate given by:

$$\bar{P} = (1-R)P_0 + R(P_1) \tag{6}$$

For the first research question, it was assumed that there is an approximately equal distribution of males and females (*Pcnt N X =1*), and the rate of being employed full-time is in the range of 17% (P_0). P_1 is the rate of being employed full-time when the gender variable is increased to one standard deviation above the mean. Increasing the rate from P_0 to P_1 in this way is the method the Power and Sample Size (PASS) software uses to create a difference in rates in order to complete the sample size calculation. The odds ratio is $[P_1/(1-P_1)]/[P_0/(1-P_0)]$. The power, or the probability of rejecting a false null hypothesis is set at

80%, which corresponds to a beta value of 20% or the probability of accepting a false null hypothesis. The alpha value, or the probability of rejecting a true null hypothesis is set at 5%. For a moderately strong association, the R-squared value is estimated at 0.65. N is the size of the sample drawn from the population.

Analyzing the first research question using the whole population of IMGs (n~4,500), we will be able to detect significant associations with Odds Ratios of 1.45 or higher. Note: Odds Ratios are calculated with 80% power at a 5% level of significance and calculations were conducted using the Power and Sample Size (PASS) software. The following output is used to show the optimal sample size calculated:

Table 15. Sample size calculation output for first research question

Power	N	Percent N X=1	P_0	P_1	Odds Ratio	R^2	α	β
0.79994	8621	50	0.170	0.210	1.298	0.65	0.05	0.20006
0.79981	5625	50	0.170	0.220	1.377	0.65	0.05	0.20019
0.79972	3979	50	0.170	0.230	1.458	0.65	0.05	0.20028
0.79968	2976	50	0.170	0.240	1.542	0.65	0.05	0.20032
0.79977	2318	50	0.170	0.250	1.627	0.65	0.05	0.20023
0.79951	1862	50	0.170	0.260	1.715	0.65	0.05	0.20049
0.79972	1532	50	0.170	0.270	1.806	0.65	0.05	0.20028

The following output is used to show the power calculation:

Table 16. Power calculation output for first research question

Power	N	Percent N X=1	P_0	P_1	Odds Ratio	R^2	α	β
0.52501	4500	50	0.170	0.210	1.298	0.65	0.05	0.47499
0.70695	4500	50	0.170	0.220	1.377	0.65	0.05	0.29305
0.84576	4500	50	0.170	0.230	1.458	0.65	0.05	0.15424
0.93126	4500	50	0.170	0.240	1.542	0.65	0.05	0.06874
0.97415	4500	50	0.170	0.250	1.627	0.65	0.05	0.02585
0.99181	4500	50	0.170	0.260	1.715	0.65	0.05	0.00819
0.99781	4500	50	0.170	0.270	1.806	0.65	0.05	0.00219

The second research question examined IMG users at the Access Centre, with the exclusion of those with pending status between 0 and 6 months since time of registration (n~2,400), in keeping with inclusion/exclusion criteria. The gender variable was used for power and sample size calculations because it is expected that it will be a significant factor

for professional integration outcomes. For example, McDonald et al. (2009) found that female IMGs had lower odds of working as a physician (OR=0.71, 95% CI=0.56, 0.91) than Canadian-born female physicians; which was an analogous, but distinct outcome [12].

To assess the association between a binary dependent variable, time to professional integration, and a binary independent variable, in this case gender, adjusting for other covariates, the sample size formula under the survival analysis model using the log-rank test (Mantel-Cox test) is:

$$N = \frac{4}{(P_0 + P_1)} \frac{\left(z_{1-\alpha/2} + z_{1-\beta}\right)^2}{\left[\ln(\lambda)\right]^2} \quad (7)$$

Where P_0 is the event rate at $X_1 = 0$ and P_1 is the event rate at $X_1 = 1$ and λ is the hazard ratio, or $\log(S_2)/\log(S_1)$, where $S_2 = 1 - P_1$, and $S_1 = 1 - P_0$. The log-rank test was meant to test the null hypothesis that the survival functions do not differ across groups (for instance, men and women for the gender variable).

In this case, the "event" of interest is not death, but securing a residency position; therefore, "survival" in this case, means not securing a residency position within the study period. The desired outcome is securing the residency position within the study period. To consider the association between time to securing a residency position and binary independent variables, adjusting for other covariates, it was assumed that there is an approximately equal distribution of males and females (N_1, sample size of females $\approx N_2$, sample size of males), and the rate of professional integration was assumed to be 12% (P_0) in the population of IMG users. P_1 is the rate of professional integration when the gender variable is increased to one standard deviation above the mean. N is the combined sample size ($N = N_1+N_2$).

With the current sample size of about 2,400, we will be able to detect significant associations with Hazard Ratios of approximately 1.4 or higher, with 80% power at a 5% level of significance. In the sample, there will be an approximately equal number of men and women ($N_1 = N_2 = 1{,}200$), and the survival rate will range from 84-88% (a difference in survival of 4% or higher among men and women can be detected, while smaller differences cannot be detected). The following output is used to show the optimal sample size calculated:

Table 17. Sample size calculation output for second research question

Power	N	N_1	N_2	S_1	S_2	Hazard Ratio	α	β
0.8000	1310	655	655	0.880	0.825	1.5049	0.05	0.2000
0.8002	1562	781	781	0.880	0.830	1.4576	0.05	0.1998
0.8001	1899	950	949	0.880	0.835	1.4106	0.05	0.1999
0.8001	2366	1183	1183	0.880	0.840	1.3639	0.05	0.1999
0.8001	3042	1521	1521	0.880	0.845	1.3175	0.05	0.1999
0.8001	4075	2038	2037	0.880	0.850	1.2713	0.05	0.1999

E is the number of events required, E_1 is the required number of events in group 1 (women) and E_2 is the required number of events in group 2 (men). S_1 is the proportion surviving in group 1 (women not securing a residency position), and S_2 is the proportion surviving in group 2 (men not securing a residency position). In the sample, approximately 166 women and 165 men will obtain residency positions, while 88% of women and 84% of men will not. A difference of 4% or higher between groups with a hazard ratio of about 1.4 or higher can be detected. The power, or the probability of rejecting a false null hypothesis is set at 80%, which corresponds to a beta value of 20% or the probability of accepting a false null hypothesis. The alpha value, or the probability of rejecting a true null hypothesis is set at 5%. The following output is used to show the number of events needed (event report):

Table 18. Event report output for second research question

Power	E	E_1	E_2	S_1	S_2	Hazard Ratio	α	β
0.8000	193	97	96	0.880	0.825	1.5049	0.05	0.2000
0.8002	226	114	112	0.880	0.830	1.4576	0.05	0.1998
0.8001	271	136	135	0.880	0.835	1.4106	0.05	0.1999
0.8001	331	166	165	0.880	0.840	1.3639	0.05	0.1999
0.8001	418	210	208	0.880	0.845	1.3175	0.05	0.1999
0.8001	550	276	274	0.880	0.850	1.2713	0.05	0.1999

5.0. RESULTS

5.1. Objective ① - Descriptions of IMGs by variables in Access Centre database

Table 19 contains registration variables. These are presented as proportions of all the IMGs who registered between Jan. 1, 2007 and April 14, 2011 (n=8373). More than 60% did not use the Access Centre's services beyond initial registration (they were regarded as non-users), compared with 40% who became users of services. By looking at user type, users were further broken down into those who were admitted to residency (professionally integrated, 4.6%), found alternate careers, in terms of other employment or education/training (0.4%), were current users (24%) and were prospective users (who were being followed up, 10%).

Of those IMG users that became professionally integrated, 350 out of 385 were admitted to residency programs in Canada or the United States and 35 out of 385 secured residencies outside of those countries. Whether an IMG found a residency position was a voluntary phone call or email from the IMG informing the Access Centre of this event. Also only 4.2% became professionally integrated in Canada/US, compared to 95.8% who did not[40]. The registration date (day, month, and year) variable was used to derive other variables such as the time from graduation until registration at the Access Centre. The breakdown of IMGs by registration year is as follows: 18% in 2007, 30% in 2008, 22% in 2009 and 24% in 2010, while only 5% in 2011. This may be because the complete years (2007, 2008, and 2009) were included from Jan. 1 to Dec. 31 where the distributions were fairly similar, while only Jan. 1 to April 14 was included in 2011.

Table 20 contains demographic variables. The sample contains roughly 20% Canadian citizens, over twice that many permanent residents, and few temporary residents and others (which included those on a work permit, live-in caregivers, and those who did not answer); 14% of registrants were not currently in Canada.

[40] Note that the account number (entry), and status (with the Access Centre) variables are not in *Table 20*. This is because all of them are 100% complete; account number is the unique identifier for each IMG, and the status variable was re-categorized into the user type, user indicator and integration variables that are further described.

Table 19. Registration variables describing IMGs at the Access Centre

Registration variables	Category	n	%
	Total	8373	100.0
User indicator	Yes	3261	38.9
	No	5112	61.1
User type	Non user	5112	61.1
	Professional integration	385	4.6
	Alternate Career Path	32	0.4
	Current User	2011	24.0
	Prospective User	833	10.0
Integration (in Canada/ United States)	Yes	350	4.2
	No	8023	95.8
Registration date (year)	2002-2006	24	0.3
	2007	1529	18.3
	2008	2504	29.9
	2009	1883	22.5
	2010	1992	23.8
	2011	441	5.3

Table 20 also shows that IMGs overwhelmingly tended to live in large cities. The city type variable was dichotomized into large city vs. not large city for the urban status variable. Note that these variables were only derived from cities in Ontario.

There were roughly equal numbers of each gender, with slightly more men than women (*Table 20*). The largest age group was between 30-39 years old, followed by 40-49, under 30, and 50 and over. Most IMGs were in Canada for either l to 5 years or less than 1 year, while fewer have been in Canada for 5 to 10 years and even fewer for over 10 years; 12% have not yet arrived in Canada, while 8% chose not to answer. Almost a third of IMGs came from South Asia (mostly India and Pakistan), while almost 18% came from West Asia (mostly Iran and Iraq), and almost 15% came from Africa. Those IMGs whose first language spoken was English or French were in the minority (14%), compared to 65% who answered 'no'; while almost 21% did not answer.

Table 20. Demographic variables describing IMGs at the Access Centre

Demographic variables	Category	n	%
	Total	8373	100.0
Citizenship status	Canadian citizen	1711	20.4
	Permanent resident	4394	52.5
	Temporary resident	470	5.6
	Other/ not answered	622	7.4
	Not in Canada	1176	14.0
City type	Town	46	0.5
	Small City	114	1.4
	Medium City	133	1.6
	Large City	5677	67.8
	Not specified city in Ontario	2391	28.6
Urban status	No	293	3.5
	Yes	5677	67.8
	Not specified city in Ontario	2391	28.5
Gender	Men	4539	54.2
	Women	3773	45.1
	Not answered	61	0.7
Age (years)	Under 30	1356	16.2
	30-39	3367	40.2
	40-49	2440	29.1
	50 and over	806	9.6
	Not answered	61	0.7
Time from entry (years)	Less than 1	3109	37.1
	1-5	2122	25.3
	5-10	921	11.0
	Over 10	527	6.3
	Not in Canada	1010	12.1
	Not answered	684	8.2
Region of origin	North America, Western Europe	499	6.0
	Africa	1225	14.6
	Caribbean, C/S America	741	8.8
	East Asia	531	6.3
	Eastern Europe	648	7.7
	South Asia	2717	32.4
	Southeast Asia	361	4.3
	West Asia	1470	17.6
	Not answered	181	2.2
First language spoken (is official language)	Yes	1175	14.0
	No	5465	65.3
	Not answered	1733	20.7

Table 21 shows the distributions of IMGs by socioeconomic variables. About a quarter of IMGs were in full-time employment, 10% in part-time or casual employment, 41% were unemployed, and 23% chose not to answer. The greatest numbers of IMGs were in the lowest income bracket (32%) or chose not to answer (31%). Roughly 4-8% of IMGs were in each of the higher income brackets. Only 8.8% of IMGs were making $75,000 and over (and this may include spousal income as well since it is not individual income, but household income). The number of people in an IMG's household increased from 8% for one to 21% for four and decreased to 4% in the over five category. A quarter of IMGs chose not to answer.

Table 21. Socioeconomic variables describing IMGs at the Access Centre

Socioeconomic variables	Category	n	%
	Total	8373	100.0
Employment status	Full-time	2125	25.4
	Part-time/ casual	835	10.0
	Not employed	3459	41.3
	Not answered	1954	23.3
Full-time employment status	Yes	2125	25.4
	No	4294	51.3
	Not answered	1954	23.3
Household income	$1-19,999	2710	32.4
	$20-29,999	723	8.6
	$30-39,999	606	7.2
	$40-49,999	342	4.1
	$50-74,999	652	7.8
	$75,000+	733	8.8
	Prefer not to answer/ not answered	2607	31.1
Number of people in household	One	680	8.1
	Two	1191	14.2
	Three	1560	18.6
	Four	1781	21.3
	Five	737	8.8
	Over Five	334	4.0
	Not answered	2090	25.0

With respect to the educational/training (*Table 22*), fewer than 30% of IMGs took the evaluating exam (MCCEE), while over 70% did not. Fewer than 20% took the qualifying exam (MCCQE1), while over 80% did not. Since the MCCEE is a prerequisite for the MCCQE1, 63% of those who took the MCCEE also took the MCCQE1. Only 8% of IMGs

took the general comprehensive clinical exam (CE1), while 91% did not. About 30% of IMGs completed their medical education in South Asia, with 16% in West Asia, 14% in Africa, 11% in Eastern Europe, and 10% in the Caribbean or Central/South America. Small numbers studied in other regions. The time from graduation until registration followed a roughly normal distribution that was skewed to the left, with the greatest numbers of IMGs in the 6-10 years (14.9%) and 11-15 years (13.7%) categories.

Table 22. Educational/training variables describing IMGs at the Access Centre

Educational/training variables	Category	n	%
	Total	8373	100.0
Took MCCEE	Yes	2412	28.8
	No	5961	71.2
Took MCCQE1	Yes	1521	18.2
	No	6852	81.8
Took CE1	Yes	680	8.1
	No	7693	91.2
Region of education	North America, Western Europe	524	6.3
	Africa	1181	14.1
	Caribbean, C/S America	837	10.0
	East Asia	527	6.3
	Eastern Europe	941	11.2
	South Asia	2549	30.4
	Southeast Asia	350	4.2
	West Asia	1344	16.0
	Not answered	120	1.4
Time from graduation until registration (years)	Less than 1	393	4.7
	1-5	962	11.5
	6-10	1245	14.9
	11-15	1144	13.7
	16-20	828	9.9
	21-25	619	7.4
	Over 25	459	5.5
	Not answered	2723	32.5

5.2. Objective ② - Analysis of two principal research questions

This section is organized according to each of the research questions on: baseline employment status and professional integration outcomes. The data for each of the questions is described, the models are developed, and the final models are presented.

5.3. Baseline employment status

5.3.1. Description of the full-time status cross-sectional data

Baseline full-time employment status was defined by an IMG who, at the time of registration, was working in a full-time job in any field (IMGs were not licensed to practice medicine in Canada). IMGs who were in part-time work, casual work, or not employed were grouped into the 'not full-time employment status' category. Excluded from this analysis were: those who did not specify their baseline employment status (N=1954), those who did not specify their age or gender or those who were not living in Ontario, Canada, and those who registered before Jan. 1, 2007 (*Figures 8 & 9*). Three subgroups of IMGs were present: entire population of IMG clients, after exclusions (N=4638), IMGs who later became users of the Access Centre (N=2709) and IMGs who did not have contact with the Access Centre beyond initial registration (non-users, ,N=1929).

To clarify, with regards to IMGs in full-time employment at the time of registration, 1013 IMGs were not living in Canada, while 88 IMGs were living in a Canadian province other than Ontario. There were no IMGs with unknown gender, while there were 26 IMGs with unknown age. IMGs who registered before the study start date (January 1, 2007) numbered 24 (with 22 of the 24 who also did not provide either their age, gender, were not living in Canada or were living in another Canadian province). These exclusions summed to 1127 IMGs total.

After exclusions, there were 996 IMGs in full-time employment status who met the inclusion criteria. Of that number, 514 became users of the Access Centre, while 482 did not.

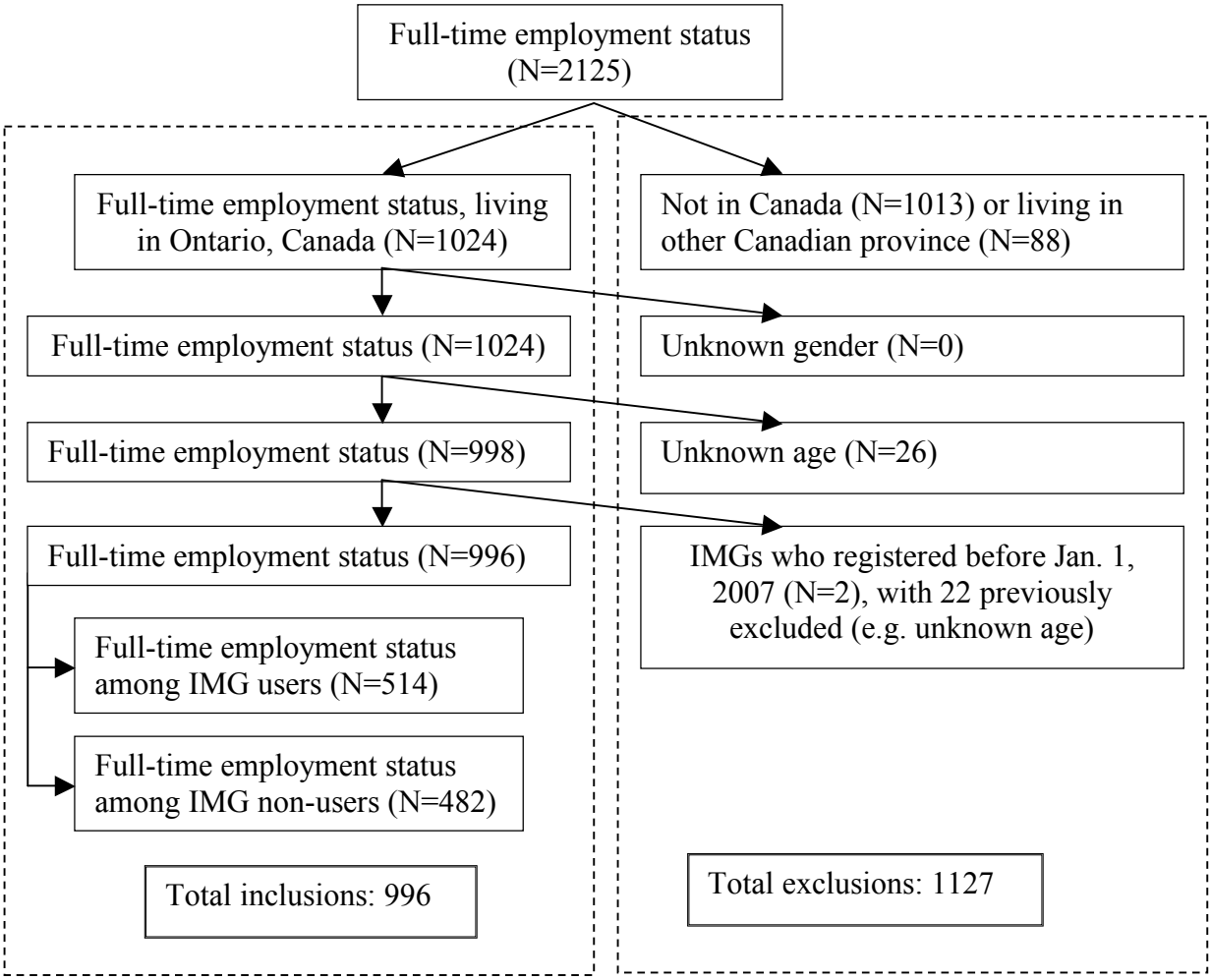

Figure 8. Full-time employment status inclusion/ exclusion flow chart

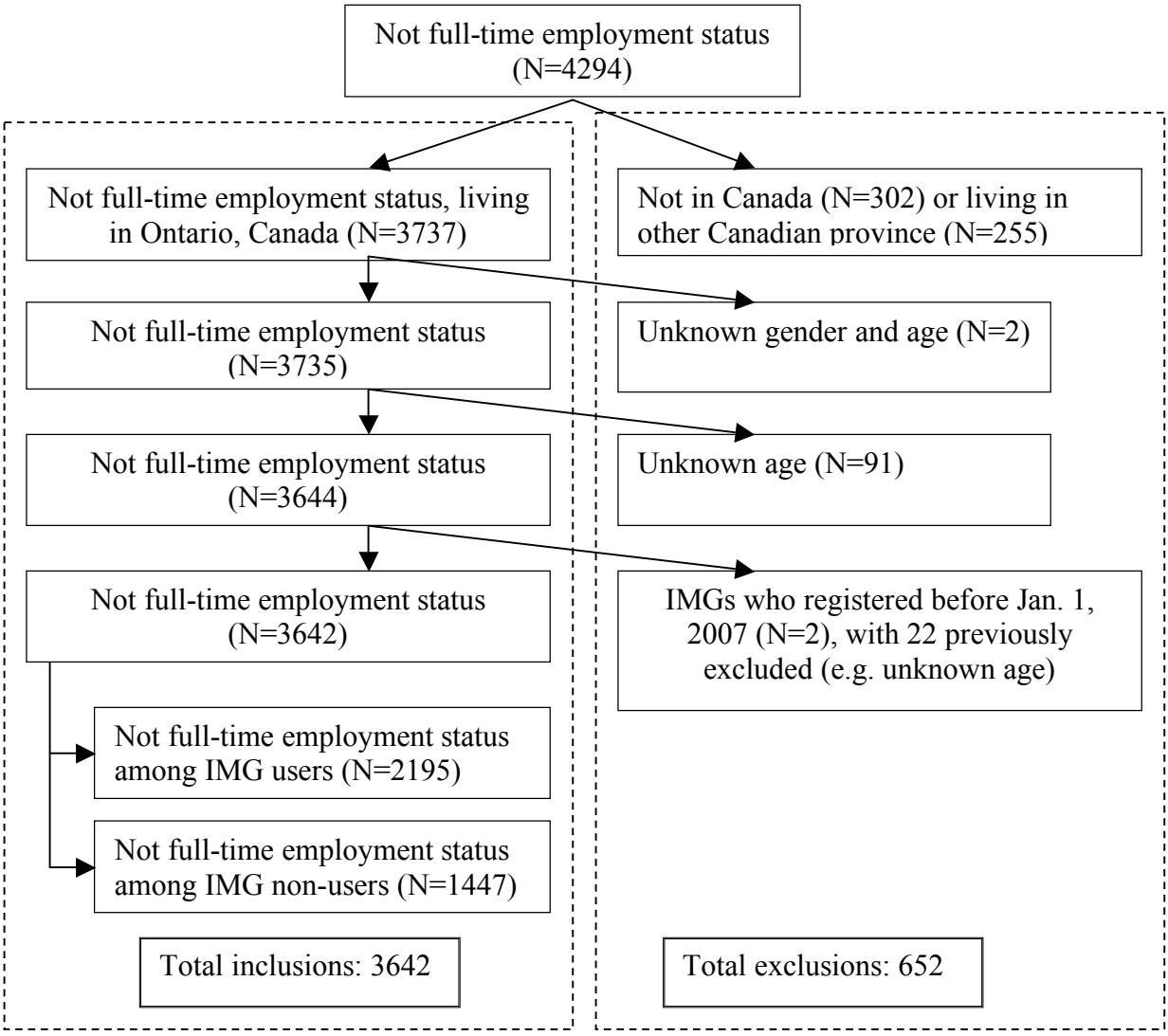

Figure 9. Not full-time employment status inclusion/ exclusion flow chart

To clarify, with regards to IMGs not in full-time employment at the time of registration, 302 IMGs were not living in Canada, while 255 were living in a Canadian province other than Ontario. 2 IMGs did not provide both their gender and age. 91 IMGs did not provide their age. IMGs who registered before the study start date numbered 24. These exclusions summed to 652 IMGs total.

After exclusions, there were 3642 IMGs not in full-time employment status who met the inclusion criteria. Of that number, 2195 became users of the Access Centre, while 1447 did not.

5.3.2. Model development for full-time status data

The initial selection of covariates of interest was determined to be those ten that had been previously used in literature and/or had the least missing data, after exclusions:

Demographic variables	Educational/training variables	Registration variables
▪ Gender ▪ Age ▪ City type/ urban status ▪ Citizenship status ▪ Region of origin ▪ Time from entry ▪ First language spoken (is official language)	▪ Region of education ▪ Time from graduation to registration	▪ Registration date (used to derive time from graduation/entry variables)

It was important to check whether there were differences in the amount of missing data for IMGs who were working full-time or not working full-time for each variable. If there were a greater number percent missing in the one category compared to the other, then the distribution of IMGs within strata would be skewed, which would, in turn affect the results.

Complete information was available on *gender* and *age* by full-time status as IMGs with unknown *gender* or *age* were excluded. The percent missing in all variables was 2% or lower, except *first language spoken (is official language)* and *time from graduation to registration (Table 23)*. However, the difference in the % missing between IMGs in full-time and not full-time did not exceed 4% in any variable *(Table 23)*. For the two variables with higher percent missing data, 'not answered' categories were created in order to keep as much data as possible for analysis. In the end, after initial predictor selection and cross-tabulations, the model could be built on all ten potential variables.

Table 23. Percent missing of each variable by full-time/not full-time employment status

Variable	Full-time		Not full-time		% Difference
	n	%	n	%	
Total	996	100	3642	100	-
Gender	0	0	0	0	0
Age	0	0	0	0	0
City type	5	0	0	0	0
Urban status	5	0	0	0	0
Citizenship status	17	2	31	1	1
Region of origin	2	0	17	0	0
Time from entry	20	2	38	1	1
First language spoken (is official language)	181	18	498	14	4
Region of education	2	0	17	0	0
Time from graduation to registration	165	16	489	13	3

A univariate analysis of baseline full-time employment status by each variable was carried out. Characteristics of IMGs who were (or were not) in full-time employment, at the time of registration at the Access Centre, were described (*Table 24*). Percentage-wise, there were more men (57%) than women (43%) in full-time status, while there were more women (53.5%) than men (46.5%) not in full-time status. There were more IMGs under 30 not in full-time status (17.4%) than IMGs under 30 in full-time status (9.3%). There were equal numbers of IMGs in the 30-39 year group who were in full-time or not in full-time status (41.5%). There were fewer IMGs 40-49 years old not in full-time (30.2%) compared to those in full-time (37.8%). There were roughly equal numbers of IMGs in the 50 and over age group (11%) in full-time and not in full-time status. Most IMGs lived in a large city (around 95%) no matter if they were in full-time or not full-time employment. A greater percentage of IMGs from South Asia were not in full-time (39%) vs. full-time employment (30%). Similarly, a greater percentage of IMGs from West Asia were not in full-time (22%) vs. full-time employment (13%). A greater percentage of IMGs from Eastern Europe were in full-time (13%) vs. not in full-time employment (5%). Also, a greater percentage of IMGs from Africa were in full-time (13%) vs. not in full-time employment (7%). Other *regions of origin* had roughly equal amounts (percentage-wise) in full-time or not in full-time employment.

There were twice as many Canadian citizens in full-time (41%) than not in full-time employment (20%). On the other hand, there were many more permanent residents not in

full-time (73%) compared to full-time employment (44%). In terms of temporary residents[41], there were roughly equal amounts in full-time and not in full-time employment (5%), while there were five times more IMGs in the other/not answered category in full-time vs. not full-time employment. There were almost twice as many IMGs, who were in Canada less than 1 year, not in full-time (51%) compared to full-time status (29%), while there were roughly equal amounts of IMGs who have been in Canada 1-5 years in full-time or not in full-time status (31%). There were twice as many IMGs who have been in Canada 5-10 years in full-time (22%) compared to not full-time status (11%) and almost three times as many IMGs who have been in Canada over 10 years in full (15%) compared to not full-time status (6%). There were roughly equal amounts of IMGs whose first language was not English or French in full-time (69%) as not full-time status (73%).

There were more IMGs who completed their medical school in South Asia not in full-time (36%) compared to full-time status (29%); the same was true of IMGs who studied in West Asia where almost twice were not in full-time status (20%) compared to full-time status (11%). On the other hand, there were more IMGs who studied in East Asia who were full-time (13%) compared to not full-time status (5%); the same was true of IMGs who studied in Eastern Europe who were in full-time (16%) compared to not full-time status (11%). There were twice as many IMGs who studied in North America, Western Europe who were full-time status (4%) compared to not full-time status (2%). There were also about equal amounts of IMGs who studied in Africa who were in full-time (12%) as not full-time employment (13%). The same was true for IMGs who studied in the Caribbean, C/S America, where there were similar numbers in full-time (10%) compared to not full-time (8%) employment status. Those IMGs who studied in Southeast Asia also had similar numbers in full-time (6%) compared to not full-time status (5%). There were also twice as many IMGs who are under 1 year from graduation, who are not in full-time (6%) compared to full-time status (3%). There were more IMGs not in full-time compared to full-time status in categories: 1-5 years, 6-10 years from graduation; while there were more IMGs in full-time employment in categories: 11-15 years, 16-20 years, and 21-25 years since graduation. There were also roughly equal numbers of IMGs over 25 years since graduation in full-time employment (8%) as not (7%).

[41] Some temporary residents were on a visitor or tourist visa, and did not intend to work full-time, while others were working either full-time or part-time/casually.

Table 24. Characteristics of IMGs by baseline full-time employment status

#	Characteristic	Total		Full-time employment status				p
				Yes		No		
		n	%	n	%	n	%	
		4638	100.0	996	100.0	3642	100.0	
1	Gender							<0.0001
	Women	2375	51.2	428	43.0	1947	53.5	
	Men	2263	48.8	568	57.0	1695	46.5	
2	Age							<0.0001
	Under 30	728	15.7	93	9.3	635	17.4	
	30-39	1925	41.5	413	41.5	1512	41.5	
	40-49	1476	31.8	376	37.8	1100	30.2	
	50 and over	509	11.0	114	11.4	395	10.8	
3	City of type							0.0952
	Town	35	0.8	13	1.3	22	0.6	
	Small City	88	1.9	22	2.2	66	1.8	
	Medium City	99	2.1	24	2.4	75	2.1	
	Large City	4411	95.2	936	94.0	3475	95.4	
4	Urban status							0.0651
	No	222	4.8	59	5.9	163	4.5	
	Yes	4411	95.2	936	94.0	3475	95.4	
5	Region of origin							<0.0001
	North America, Western Europe	133	2.9	39	3.9	94	2.6	
	Caribbean, C/S America	589	12.7	121	12.1	468	12.9	
	East Asia	329	7.1	88	8.8	241	6.6	
	Eastern Europe	329	7.1	132	13.3	197	5.4	
	Africa	391	8.4	126	12.7	265	7.3	
	South Asia	1706	36.8	298	29.9	1408	38.7	
	Southeast Asia	225	4.8	59	5.9	166	4.6	
	West Asia	917	19.8	131	13.2	786	21.6	
	Not answered	19	0.4	2	0.2	17	0.5	
6	Citizenship status							<0.0001
	Canadian Citizen	1144	24.7	406	40.8	738	20.3	
	Permanent Resident	3089	66.6	440	44.2	2649	72.7	
	Temporary Resident	231	5.0	54	5.4	177	4.9	
	Other/ not answered	174	3.8	96	9.6	78	2.1	
7	Time from entry							<0.0001
	Less than 1 Year	2134	46.0	288	28.9	1846	50.7	
	1-5 Years	1451	31.3	322	32.3	1129	31.0	
	5-10 Years	636	13.7	219	22.0	417	11.5	
	Over 10 Years	359	7.7	147	14.8	212	5.8	
	Not answered	58	1.3	20	2.0	38	1.0	
8	First language spoken (is official language)							0.0018
	No	3349	72.2	691	69.4	2658	73.0	

#	Characteristic	Total		Full-time employment status				p
				Yes		No		
		n	%	n	%	n	%	
		4638	100.0	996	100.0	3642	100.0	
	Yes	610	13.2	124	12.4	486	13.3	
	Not answered	679	14.6	181	18.2	498	13.7	
9	Region of education							<0.0001
	North America, Western Europe	124	2.7	38	3.8	86	2.4	
	Africa	576	12.4	115	11.5	461	12.7	
	Caribbean, C/S America	384	8.3	100	10.0	284	7.8	
	East Asia	327	7.0	129	13.0	198	5.4	
	Eastern Europe	569	12.3	156	15.7	413	11.3	
	South Asia	1580	34.1	287	28.8	1293	35.5	
	Southeast Asia	225	4.8	56	5.6	169	4.6	
	West Asia	844	18.2	112	11.2	732	20.1	
	Not answered	9	0.2	3	0.3	6	0.2	
10	Time from graduation							<0.0001
	Under 1 Year	253	5.4	32	3.2	221	6.1	
	1-5 Years	640	13.8	106	10.6	534	14.7	
	6-10 Years	872	18.8	168	16.9	704	19.3	
	11-15 Years	834	18.0	185	18.6	649	17.8	
	16-20 Years	594	12.8	142	14.3	452	12.4	
	21-25 Years	452	9.7	120	12.0	332	9.1	
	Over 25 Years	339	7.3	78	7.8	261	7.2	
	Not answered	654	14.1	165	16.6	489	13.4	

Fisher's exact tests or chi-square tests showed whether there was a difference between each variable/level by full-time/not full-time status. *City type* (p=0.0952) and *urban status* (p=0.0651) did not have significant p-values, and were not included in the cross-sectional analysis. It was apparent that those who did not specify their *region of origin* (only 19 individuals) or *region of education* (only 9 individuals) should be excluded to avoid low cell counts. Within the variables: *time from entry, first language spoken (is official language)* and *time from graduation*, a category for those who did not answer was included. This was because a 'not answered' category for those variables was not strictly part of the exclusion criteria, and something could still be said about those who chose not to answer those questions. For those who did not answer the *citizenship status* question, the 'not answered' category was combined with the 'other' category, to avoid low cell counts; and since very few IMGs did not answer this question on the online registration form.

After running a preliminary logistic regression with all of the variables, the problem

of quasi-complete separation of points[42] came up. This may have been due to low cell counts in some categories of variables. *Time from entry* was cross-tabulated with *region of origin*, and low cell counts (less than 5 individuals in a cell) were found for the 'not answered' category. Therefore, the 'not answered' category of the *time from entry* variable was removed (N=58).

Stepwise selection of covariates was carried out and is described in more detail. The covariates chosen for the analysis thus far included: *gender, age, time from entry, citizenship status, region of origin, region of education, first language spoken (is official language),* and *time from graduation*. Stepwise selection using SAS software for these covariates with an entry p-value of 0.25 and a stay p-value of 0.05 also tested for all two-way interactions. Variables included and excluded are described (*Table 25*).

Table 25. Variables/interactions included an excluded by stepwise selection

Variables/interactions included		**Variables excluded**
1. *Citizenship status*	1. Interaction of *gender* and *time from entry*	1. *First language spoken (is official language)*
2. *Region of origin*	2. Interaction of *age* and *region of origin*	2. *Time from graduation*
3. *Gender*	3. Interaction of *region of origin* and *time from entry*	3. *Region of education*
4. *Time from entry*	4. Interaction of *gender* and *age*	
5. *Age*		

A factor that was kept in the model to be controlled for was *first language spoken (is official language)*, which had a p-value close to 0.25. On the other hand, *time from graduation* was not significant, with a p-value close to 0.95, and it was decided that it would not have added anything more to the model. *Region of education* was not kept in the model since it was later found to be collinear with *region of origin*.

The stepwise selection method detected four two-way interactions between the variables of interest. To understand these interactions more, cross-tabulations were performed on each of the interacting terms crossed against the other by full-time and not full-time employment status (*Table 26, 27, 28, 29, 30* and *31*).

[42] Quasi-complete separation of points suggests the data are not 'separable' and yield nonunique infinite estimates. To address this, the model can be changed; a different likelihood method and/or exact computations can be used. In this case, changing the model by removing 'low cell count' categories alleviated the problem.

Table 26. Gender and time from entry for IMGs by employment status (N=4560)

	Not full-time (N=3588)				**Full-time** (N=972)			
Gender	**Women**		**Men**		**Women**		**Men**	
Time from entry	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Total	1916	100.0	1672	100.0	416	100.0	556	100.0
Less than 1 Year	860	44.9	980	58.6	92	22.1	196	35.3
1-5 Years	679	35.4	445	26.6	119	28.6	203	36.5
5-10 Years	264	13.8	151	9.0	124	29.8	94	16.9
Over 10 Years	113	5.9	96	5.7	81	19.5	63	11.3

The above table (*Table 26*) shows the numbers and percentages of IMGs with time from entry (time in Canada) compared to full-time status in men and women. The distribution of women who are not in full-time status by times in Canada shows that most of them have been in Canada a short period of time (for instance, 44.9% have been in Canada less than 1 year). The same is true for men who are not in full-time status, although generally more men that are not working full-time have been in Canada a shorter period of time (for instance, 58.6%). The distribution of women, who are working full-time, shows that many more of them have been in Canada a longer period of time. The same is true of men working full-time, but to a lesser extent. Differences across *gender* and *time from entry* by full-time employment status were present, which have been accounted for by including this interaction term.

Tables 27 and *28* show the distribution of IMGs in full-time and not full-time employment, respectively, by region of origin and age. South Asians represented the greatest share of the population of each *age* group, while North Americans and Western Europeans represented the smallest share. The pattern for *regions of origin* was fairly similar across all *age* groups. There were differences between IMGs who were in full-time and not in full-time employment, which have been accounted for by including this interaction term. In addition, in the case of IMGs in full-time employment, the cross tabulation showed a number of instances of low cell counts, 5 or lower; for instance there was only 1 IMG from North America or Western Europe who was 50 or over years old in full-time employment.

Table 27. Age by region of origin for IMGs not in full-time employment (N=3588)

Age (years)	Under 30		30-39		40-49		50 and over	
Region of origin	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Total	623	100.0	1489	100.0	1086	100.0	390	100.0
North America, Western Europe	35	5.6	35	2.3	15	1.4	6	1.5
Africa	75	12.0	171	11.5	153	14.1	64	16.4
Caribbean, C/S America	50	8.0	105	7.0	58	5.3	24	6.1
East Asia	14	2.3	81	5.4	82	7.6	18	4.6
Eastern Europe	45	7.2	125	8.4	73	6.7	21	5.4
South Asia	283	45.4	593	39.8	351	32.3	167	42.8
Southeast Asia	16	2.6	69	4.6	61	5.6	20	5.1
West Asia	105	16.8	310	20.8	293	27.0	70	17.9

Table 28. Age by region of origin for IMGs in full-time employment (N=972)

Age (years)	Under 30		30-39		40-49		50 and over	
Region of origin	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Total	92	100.0	401	100.0	370	100.0	109	100.0
North America, Western Europe	5	5.4	23	5.7	6	1.6	1	0.9
Africa	9	9.8	43	10.7	53	14.3	14	12.8
Caribbean, C/S America	22	23.9	39	9.7	19	5.1	6	5.5
East Asia	6	6.5	47	11.7	71	19.2	5	4.6
Eastern Europe	13	14.1	44	11.0	50	13.5	17	15.6
South Asia	24	26.1	115	28.7	104	28.1	49	44.9
Southeast Asia	3	3.3	26	6.5	26	7.0	4	3.7
West Asia	10	10.9	64	16.0	41	11.1	13	11.9

Likewise, a table was created by crossing *time from entry* and *region of origin* by full-time employment status (*Table 29* and *30*). The patters for *regions of origin* were fairly similar across *age* groups, where the greatest numbers of IMGs came from South Asia (between 25%-45%), while the least came from North America or Western Europe (between 1% and 7%). IMGs from Caribbean or Central/South America that were less than 1 year in Canada not in full-time status (7%) compared to full-time status (12%) exemplified some differences. Therefore, including the interaction term was necessary.

Table 29. Time from entry by region of origin for IMGs not full-time (N=3588)

Time from entry	Less than 1 Year		1-5 Years		5-10 Years		Over 10 Years	
Region of origin	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Total	1820	100.0	1124	100.0	415	100.0	209	100.0
North America, Western Europe	48	2.6	23	2.0	6	1.4	14	6.7
Africa	254	13.8	156	13.9	29	7.0	24	11.5
Caribbean, C/S America	127	6.9	72	6.4	29	7.0	9	4.3
East Asia	76	4.1	68	6.0	36	8.7	15	7.2
Eastern Europe	97	5.3	95	8.4	46	11.1	26	12.4
South Asia	717	39.0	414	36.8	186	44.8	77	36.8
Southeast Asia	119	6.5	30	2.7	8	1.9	9	4.3
West Asia	402	21.8	266	23.7	75	18.1	35	16.7

Table 30. Time from entry by region of origin for IMGs in full-time status (N=972)

Time from entry	Less than 1 Year		1-5 Years		5-10 Years		Over 10 Years	
Region of origin	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Total	288	100.0	322	100.0	218	100.0	144	100.0
North America, Western Europe	17	5.9	10	3.1	2	0.9	6	4.2
Africa	43	14.9	45	14.0	16	7.3	15	10.4
Caribbean, C/S America	35	12.1	42	13.0	6	2.7	3	2.1
East Asia	14	4.9	28	8.7	54	24.8	33	22.9
Eastern Europe	18	6.2	36	11.2	42	19.3	28	19.4
South Asia	97	33.7	101	31.4	57	26.1	37	25.7
Southeast Asia	19	6.6	19	5.9	12	5.5	9	6.2
West Asia	45	15.6	41	12.7	29	13.3	13	9.0

A table of frequencies for *age* and *gender* by full-time employment status was made (*Table 31*). The largest group of IMGs, no matter the full-time status was the '30-39' age group (between 37%-45%). For each *age* group, there was a trend in the numbers of female and male IMGs. In the younger *age* groups ('Under 30' and '30-39'), there were more women than men, while in the older *age* groups ('40-49' and '50 and over') there were more men than women. There were noticeable differences, though, between IMGs in full-time and not full-time employment as a function of their *gender* and *age*. This was most apparent in the difference in composition, where, for instance, only 11.5% of women were in the 'Under

30' age group for IMGs in full-time status, compared to 20.9% for those not in full-time statuses. Therefore, these differences have been accounted for by including this interaction term.

Table 31. Age and gender for IMGs by employment status (N=4560)

	Not full-time (N=3588)				**Full-time** (N=972)			
Gender	**Female**		**Male**		**Female**		**Male**	
Age (years)	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Total	1916	100.0	1672	100.0	416	100.0	556	100.0
Under 30	401	20.9	222	13.3	48	11.5	44	7.9
30-39	865	45.1	624	37.3	163	39.2	238	42.8
40-49	502	26.2	584	34.9	162	38.9	208	37.4
50 and over	148	7.7	242	14.5	43	10.3	66	11.9

With regards to the interaction terms detected to be significant through stepwise selection, there appeared to be some patterns present when each combination of variables was cross tabulated.

Next, it was important to check for collinearity with regards to *region of origin* and *region of education*, and others. Collinearity was detected by Spearman rank correlation coefficients (*Table 32)*. The variables with the greatest Spearman correlations were: *region of origin* and *region of education* (0.878). Moderate levels of correlation included: *age* and *time from graduation* (0.617). Due to the expected high correlation between *region of origin* and *region of education*, models constructed included only one or the other variable. The moderate correlation did not pose a problem, since *time from graduation* was previously removed via stepwise selection.

Table 32. Spearman rank correlation coefficients (N=4560)

Variable	Gender	Age	Citizen-ship status	Region of origin	Time from entry	Region of edu-cation	First lang. spoken	Time from grad.
#	1	2	3	4	5	6	7	8
1	1.000	0.146	0.095	0.023	-0.120	-0.009	0.022	0.092
2	0.146	1.000	-0.183	0.027	0.158	0.022	-0.003	0.617
3	0.095	-0.183	1.000	0.005	-0.612	0.005	-0.047	-0.145
4	0.023	0.027	0.005	1.000	-0.062	0.878	-0.086	-0.006
5	-0.120	0.158	-0.612	-0.055	1.000	-0.062	0.048	0.162
6	-0.009	0.022	0.005	0.878	-0.062	1.000	-0.064	0.002
7	0.0216	-0.003	-0.047	-0.086	0.048	-0.064	1.000	0.084
8	0.092	0.617	-0.145	-0.006	0.162	0.002	0.084	1.000

It was important to find out if there was a difference between models by including *region or origin* or *region of education* due to the collinearity problems; models were created and *Type 3 Analysis of Effects* (p-values) were compared for each variable, including interaction terms detected by stepwise selection (*Table 33*).

It was found that when both *region of origin* and *region of education* were included (model 1), both *region of origin* and *region of education* were not significant. However, the interaction terms of *age* and *region of origin* (p=0.0018) as well as *region of origin* and *time from entry* (p=0.0042) were significant. If *region of origin* and *region of education* were included in separate models (models 2 & 3), they were both significant. Since there was an apparent problem with collinearity (Spearman correlation coefficient=0.878), and since the stepwise selection eliminated *region of education* and kept *region of origin* in the model, it was decided that *region of origin* would be kept in the model in lieu of *region of education*.

Table 33. Type 3 Analysis of Effects compared for region of origin/education (N=4560)

Variable	Model 1 p	Model 2 p	Model 3 p
Gender	<0.0001	<0.0001	<0.0001
Age	0.1887	0.1800	0.0040
Region of origin	0.3953	0.0549	-
Region of education	0.6086	-	<0.0001
Citizenship status	<0.0001	<0.0001	<0.0001
First language spoken (is official language)	0.3403	0.3516	0.2352
Time from entry	0.7980	0.8804	<0.0001
Interaction of gender and time from entry	0.0017	0.0022	0.0008
Interaction of gender and age	0.0087	0.0111	0.0044
Interaction of age and region of origin	0.0018	0.0014	-
Interaction of region of origin and time from entry	0.0042	0.0032	-

To address a different issue, separate models were to be created for IMG users, IMG non-users and both IMG users & non-users (entire population of IMGs at the Access Centre). After creating and testing a variable called, 'user indicator' which was '1' for users and '0' for non-users into the model, it was found to be highly non-significant with a chi-square value=0.0785 and a p-value=0.7793. This meant that there was no detectable difference between IMG users and IMG non-users at the time of registration with regards to baseline full-time employment status. This was to be expected, as only after registration did IMGs decide on whether they would choose to become users and use the variety of services offered by the Access Centre or to not become users and not use the services beyond initial contact (at registration). Also, their baseline full-time employment status therefore did not depend on whether they become users in the future or not. Therefore, it was not necessary to conduct a logistic regression on IMG users, and IMG non-users, separately.

5.3.3. Assessment of the model

The goodness-of-fit of the logistic regression model for baseline full-time employment status was assessed by various means. This was done to see how effectively had the model been described or if the distance between the observed and expected values was small. Three ways to test the goodness-of-fit were used: likelihood ratio test (LRT), Hosmer-Lemeshow (H-L) test, and c-statistic or the area under the receiver operating characteristic (ROC) curve (AUC).

The likelihood ratio test (LRT) was used to check if a variable (or variables) made a statistically significant contribution to the model (with and without the variable(s)). The condition being that the model contained a same number of observations. The LRT test was performed taking variables and interactions out of the model and obtaining the difference between the -2log L values (chi-square) to perform a chi-square test with the degrees of freedom (df) being equal to the difference in the number of variables between the two models.

The following was a summary of LRT tests (*Table 34*). Despite *first language spoken (is official language)* variable not making a statistically significant contribution to the model, it was decided that it was best not to discard it. In this way, this variable could account for some unobserved heterogeneity in the data.

The Hosmer-Lemeshow (H-L) test was another goodness-of-fit statistic. It formed 10 equally sizes groups of ordered, estimated outcome probabilities based on deciles of their distribution. Concordance of the expected and observed outcome frequencies in these groups was required for a good fit (e.g. failure to reject the null hypothesis indicated good fit). In this case the chi-square value=2.6479 and a p=0.9545 indicated non-significance and evidence of good fit.

The c-statistic provided a measure of the model's ability to discriminate between those IMGs who were in a full-time employment position and those who were not. In this case, c=0.756, which was between 0.7 and 0.8, indicated acceptable discrimination. A graphical representation of c-statistic was the area under the ROC curve, which plotted the sensitivity (the proportion of individuals with the outcome that were correctly classified) against the false positive rate (1-specificity or the proportion of individuals without the outcome that were correctly classified). The ROC Curve output (*Figure 10*) showed that the curve was distinct from a diagonal line (c=0.5 showing no discrimination).

Table 34. Summary of LRT results (N=4650)

Variable(s) taken out of model	df	chi-square	Crit. value	p	Interpretation
Gender - Interaction (gender, age) - Interaction (gender, time from entry)	3	102.439	7.81	<0.001	Keep variable and its interactions
Age - Interaction (gender, age) - Interaction (age, region of origin)	3	80.943	7.81	<0.001	
Region of origin - Interaction (age, region of origin) - Interaction (region of origin, time from entry)	3	182.178	7.81	<0.001	
Citizenship status	1	143.052	3.84	<0.001	
Time from entry - Interaction (gender, time from entry) - Interaction (region of origin, time from entry)	3	119.92	7.81	<0.001	
First language spoken (is official language)	1	2.063	3.84	0.15	Discard variable

Moreover, regression diagnostics were a series of measures that were used to see if the model fit, and if it was supported over the range of covariate patterns. The diagnostics included: influence diagnostics, dfbeta plots, and predicted probability diagnostics.

Influence diagnostics were used to identify data points that had disproportional influence on the estimated regression model. Due to either improperly recorded data, errors that were inherent in the data, and/or outliers that were extreme observations, some points may have had undue influence on the model.

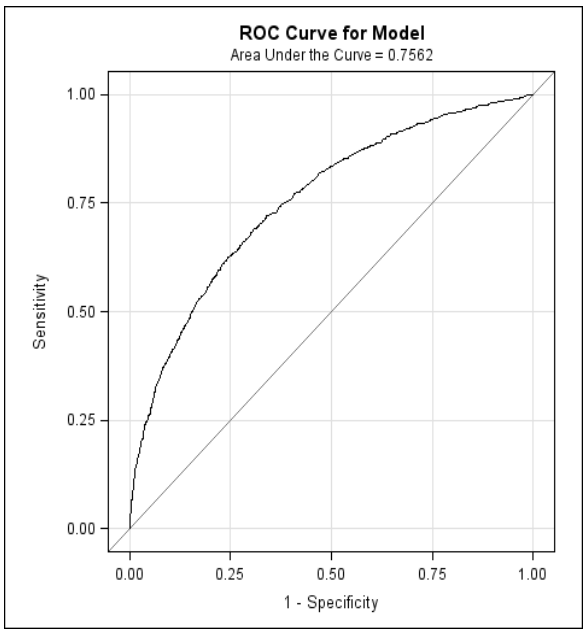

Figure 10. ROC Curve (N=4650)

Some influence measures included: *Pearson and Deviance residuals,* which showed differences between observed and fitted values; *Leverage*, which showed the potential an observation had to affect the fit of the model; *Confidence Interval (CI) Displacement C*, which measured the confidence interval displacement or influence of individual observations on the regression estimates; *CI Displacement CBAR*, which measured the confidence interval displacement or overall change in global regression estimates due to deleting an individual observation; *chi-square deletion difference*, which was a statistic that measured the chi-square goodness-of-fit after deleting an individual observation; and *deviance deletion difference*, which measured the change in deviance after deleting an individual observation.

There appeared to be some influential points on the graphs produced for the influence statistics as a function of case (obs.) number (*Figures 11 & 12*). On the *Pearson* and *Deviance residual* graphs, there did not appear to be any influential points. On the *Leverage* graph, there appeared to be one point outside of the norm (above 0.25) and it was identified as observation number 3709. On the *CI Displacement C* and *CBAR* graphs, one point was clearly outside the norm (above 1.5) and it was identified as obs. number 4354. This point was also visible on the *deviance deletion difference* graph. Other points may have appeared to be more influential, but it was not appropriate to remove them, because their values still fell within reasonable ranges, unlike the above two points, which were clearly outliers.

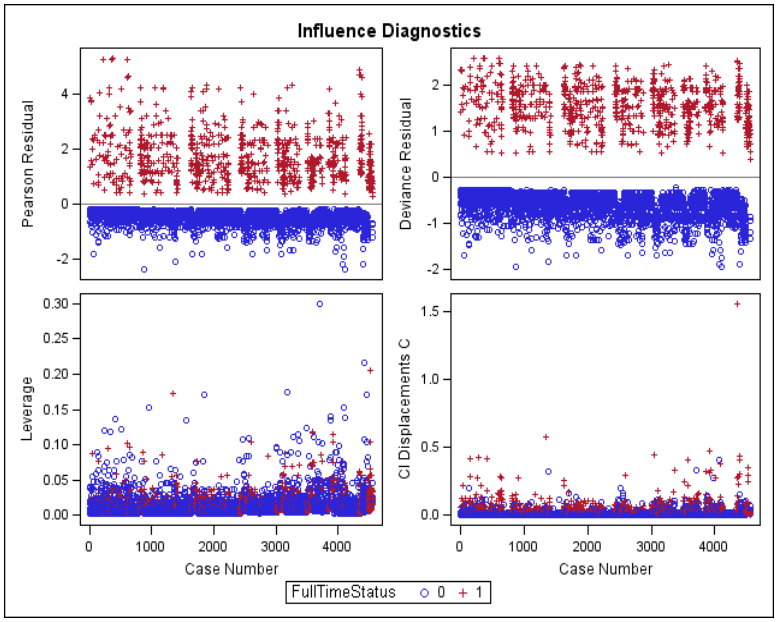

Figure 11. Influence diagnostics I (N=4560)

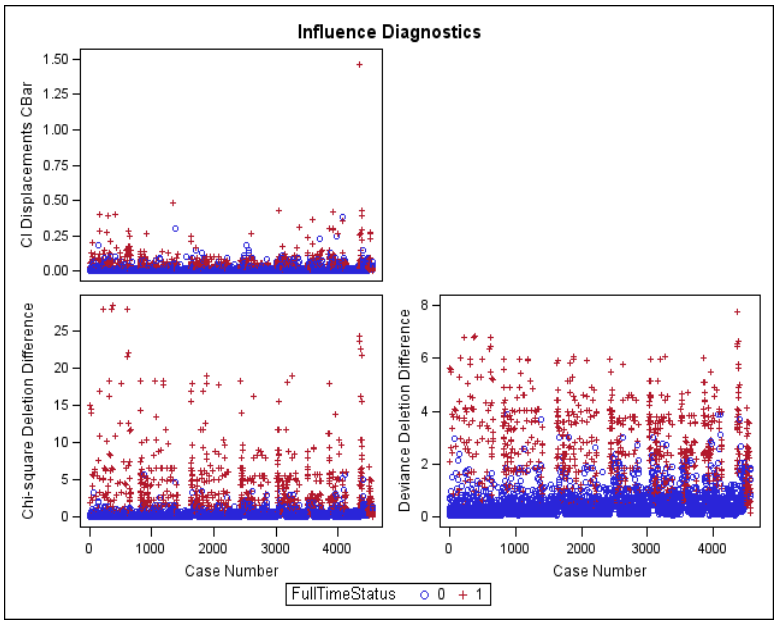

Figure 12. Influence diagnostics II (N=4560)

The values of each covariate of interest for the purported outliers were shown (*Table 35*).

Table 35. Characteristics of outliers detected by influence diagnostics

Obs. number	Entry	Full-time status	Gender	Age	Region of origin	Citizenship status	First language spoken	Time from entry
3709	AC-31729	No	Male	50 and over	North America, Western Europe	Other/not answered	Not official language	Less than 1 year
4354	080421/ JACZ	Yes	Female	50 and over	North America, Western Europe	Permanent resident	Official language	1-5 years

By removing observation numbers 3709 and 4354, the parameter estimates remained very close between the model with and without the outliers, with the exception of the interaction of *region of origin* and *age*. This was seen by some estimates increasing by 10 units and one of them changing sign from negative to positive. This may be reason to remove these two observations from the model. With the removal of the outliers, the model also improved, but only slightly (c-stat. improved from 0.756 to 0.757). The H-L test showed both models had good fit (p-values of 0.9545 and 0.9660, respectively). However, the p-value for *region of origin* changed from 0.0549 to 0.0412, making the main effect for *region of origin* significant (with the interaction of *region of origin* and *age* staying significant as well). The two outliers also appeared in the further diagnostic checks using dfbeta plots.

Dfbeta plots showed the standardized differences in the regression estimates by assessing the effects of individual observations on the parameter estimates in the fitted model (see *Appendix* for dfbeta plots). The outliers with observation numbers 4354 and 3709 appeared in the dfbeta plots for *age* and *region of origin*. This may have indicated that for that particular *age* group and *region of origin* group in each of the outliers' cases, the combination of covariates was unusual or out of the ordinary. The model fit was also improved slightly when they were removed. An additional two outliers with observation numbers 1338 and 4516 were also detected using dfbeta plots (*Table 36*).

Table 36. Characteristics of outliers detected by regression diagnostics

Obs. no.	Entry	Full-time status	Gender	Age	Region of origin	Citizen-ship status	First language spoken	Time from entry
1338	AC-26901	Yes	Female	30-39 years	North America, Western Europe	Canadian citizen	Official language	5-10 years
4516	080217/HU	Yes	Female	40-49 years	East Asia	Canadian citizen	Not answered	Over 10 years

By removing observation numbers 1338 and 4516, the parameter estimates remained very close between the model with and without the outliers. Also, the model did not improve (c-stat. remained the same at 0.756). The H-L test showed evidence of good fit for the model with and without the outliers (p-values of 9545 and 0.9597, respectively) Therefore, seeing as the model did not improve by removing these supposed outliers, they were left in the model.

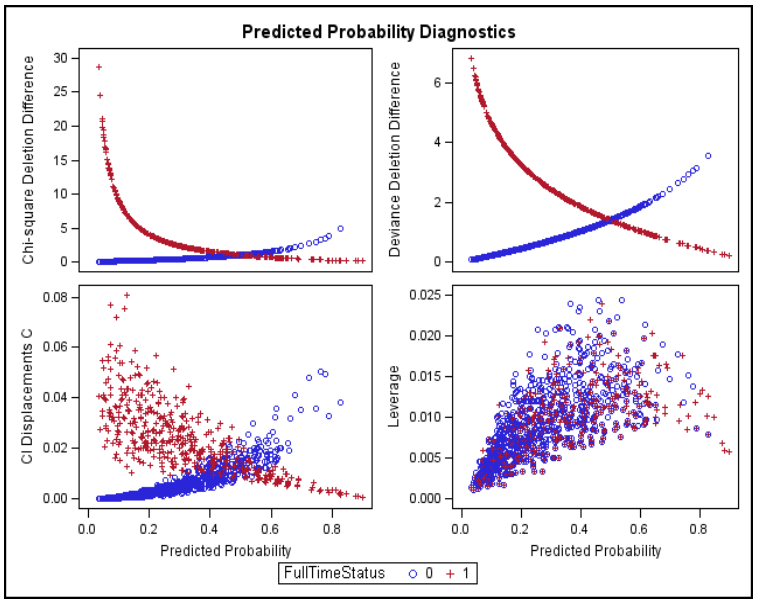

Figure 13. Predicted probability diagnostics (N=4560)

The *chi-square deletion difference, deviance deletion difference, CI Displacement C* and *Leverage* were plotted against the predicted probabilities to check for influential points or outliers. From the plots, it did not appear that any points were outside of the norm (*Figure 6*), with the exception of observation number 4354, which was at the very top of the *deviance*

deletion difference and the *chi-square deletion difference* plots. This observation, along with observation number 3709, was removed from the final model to improve model fit.

5.3.4. Final model presentation

After describing the cross-sectional data by full-time employment status; developing the model through initial selection of covariates, univariate analysis, stepwise selection, collinearity checks, and comparing models; and finally assessing the model through goodness-of-fit and regression diagnostics, a final model could be reported. The final set of covariates and interactions in the model (*Table 37*).

Table 37. Variables/interactions included in the final model

Variables/interactions included	
1. *Citizenship status* 2. *Region of origin* 3. *Gender* 4. *Time from entry* 5. *Age* 6. *First language spoken (is official language)*	1. Interaction of *gender* and *time from entry* 2. Interaction of *age* and *region of origin* 3. Interaction of *region of origin* and *time from entry* 4. Interaction of *gender* and *age*

The multivariable logistic regression model was computed from the SAS software program, for full-time vs. not full-time employment status. The logistic regression equation for resembled the following:

$$\log(odds) = \beta_0 + \beta_1 gender(Male) + \beta_2 age(Under30) + ... + \text{int}eractions$$

To find the effect of a particular covariate, the parameter estimate (or value of the coefficient) for it has to be entered into the equation (*Tables 38 & 39*). The odds ratio can be found by exponentiation. The main effects (*Table 38*) and interactions (*Table 39*) are described by the parameter estimates, standard errors and p-values for each variable of interest. Reference categories were those categories that had the most IMGs (such as more women than men; more IMGs whose first language was not French or English, and more IMGs who have been in Canada less than 1 year). The exceptions were *region of origin* and *citizenship status*. For *region of origin*, the reference category: North America, Western

Europe was chosen as reference as it included Canada; this was also the case for *citizenship status*, which used Canadian citizen as reference.

Table 38. Main effects parameter estimates (N=4558)

Coef-ficient	Variable	Variable category	Parameter Estimate	Standard Error	p
β_0	Intercept	-	-1.0399	0.4186	0.0130
-	Gender	Women (ref.)			
β_1		Men	1.0381	0.1726	<0.0001
β_2	Age (years)	Under 30	-1.1862	0.5898	0.0443
-		30-39 (ref.)	-	-	-
β_3		40-49	-0.3093	0.6142	0.6146
β_4		50 and over	-1.3861	1.1822	0.2410
-	Region of origin	North America, Western Europe (ref.)			
β_5		Africa	-0.8600	0.4477	0.0547
β_6		Caribbean, C/S America	-0.7414	0.4760	0.1193
β_7		East Asia	-0.3349	0.5171	0.5172
β_8		Eastern Europe	-0.8022	0.4976	0.1069
β_9		South Asia	-1.1152	0.4178	0.0076
β_{10}		Southeast Asia	-0.4658	0.4982	0.3498
β_{11}		West Asia	-1.0822	0.4385	0.0136
-	Citizenship status	Canadian Citizen (ref.)			
β_{12}		Permanent Resident	-0.7470	0.1323	<0.0001
β_{13}		Temporary Resident	-0.0832	0.2186	0.7035
β_{14}		Other/ not answered	1.3313	0.2123	<0.0001
-	First language spoken (is official lang.)	No (ref.)			
β_{15}		Yes	0.0161	0.1264	0.8986
β_{16}		Not answered	0.1597	0.1107	0.1491
-	Time from entry	Less than 1 Year (ref.)			
β_{17}		1-5 Years	0.0559	0.5464	0.9185
β_{18}		5-10 Years	0.1903	0.9370	0.8390
β_{19}		Over 10 Years	0.5171	0.6475	0.4245

The p-values in the table above show which variable categories are significant. For instance, *citizenship status* category, temporary resident (p=0.7035) was not significant, but other categories such as Canadian citizenship (p<0.0001) or other/not answered (p<0.0001) were significant (*Table 38*).

Table 39. Interactions parameter estimates (N=4558)

Interaction	Variable category	Interacting variable category	Param. Est.	Standard Error	p
Gender & time from entry	Female (ref.)	Less than 1 year (ref.)			
	Male	1-5 years	0.3443	0.2025	0.0891
		5-10 years	-0.2691	0.2409	0.2640
		Over 10 years	-0.6508	0.2871	0.0234
Gender & age (years)	Female (ref.)	30-39 (ref.)			
	Male	Under 30	-0.5910	0.2798	0.0347
		40-49	-0.5534	0.1888	0.0034
		50 and over	-0.5608	0.2809	0.0459
Age (years) & region of origin	30-39 (ref.)	North America, Western Europe (ref.)			
	Under 30	Africa	0.7343	0.7117	0.3022
		Caribbean, C/S America	1.8620	0.6786	0.0061
		East Asia	1.5531	0.8405	0.0646
		Eastern Europe	1.5884	0.6987	0.0230
		South Asia	0.7431	0.6300	0.2382
		Southeast Asia	1.0736	0.9211	0.2438
		West Asia	0.9454	0.6895	0.1703
	40-49	Africa	0.8420	0.6594	0.2017
		Caribbean, C/S America	0.8114	0.7019	0.2477
		East Asia	0.3138	0.6759	0.6424
		Eastern Europe	0.7811	0.6677	0.2421
		South Asia	1.0211	0.6283	0.1041
		Southeast Asia	0.2481	0.7244	0.7320
		West Asia	0.2360	0.6514	0.7171
	50 and over	Africa	1.1476	1.2194	0.3467
		Caribbean, C/S America	1.4005	1.2858	0.2761
		East Asia	-0.1834	1.3205	0.8896
		Eastern Europe	1.7009	1.2356	0.1686
		South Asia	2.0639	1.1812	0.0806
		Southeast Asia	0.4480	1.3502	0.7400
		West Asia	1.3777	1.2171	0.2577
Interaction of region of origin and time from entry	North America, Western Europe (ref.)	Less than 1 year (ref.)			
	Africa	1-5 years	0.4600	0.5961	0.4402
		5-10 years	0.9133	0.9996	0.3609
		Over 10 years	0.8190	0.7324	0.2634
	Caribbean, C/S America	1-5 years	0.7407	0.6170	0.2299
		5-10 years	-0.3912	1.0595	0.7120
		Over 10 years	-0.0389	0.9507	0.9674

Interaction	Variable category	Interacting variable category	Param. Est.	Standard Error	p
	East Asia	1-5 years	0.3122	0.6650	0.6387
		5-10 years	1.5793	1.005	0.1161
		Over 10 years	2.0397	0.7869	0.0095
	Eastern Europe	1-5 years	0.6701	0.6385	0.2939
		5-10 years	1.2494	0.9934	0.2085
		Over 10 years	1.0790	0.7415	0.1456
	South Asia	1-5 years	0.5053	0.5645	0.3707
		5-10 years	0.3798	0.9464	0.6882
		Over 10 years	0.5365	0.6632	0.4185
	Southeast Asia	1-5 years	1.0447	0.6785	0.1236
		5-10 years	1.7789	1.0838	0.1007
		Over 10 years	1.2777	0.8559	0.1355
	West Asia	1-5 years	-0.0083	0.5939	0.9889
		5-10 years	0.8887	0.968	0.3586
		Over 10 years	0.7049	0.7230	0.3296

Besides the four interactions that were found to be significant, one questioned whether any additional two-way interactions were also significant. Therefore, the interactions *gender* and *region of origin,* and *time from entry* and *age* were inputted into the model and both were found not to be significant. Also the following three-way interactions were tested: *gender*, *age,* and *time from entry*; and *age*, *region of origin*, and *time from entry*. Both three-way interactions were found not to be significant.

From the table of odds ratios for non-interacting terms (*Table 40, Figure 14*), for those of temporary resident *citizenship status*, their odds of full-time (vs. not full-time) employment were the same as Canadian citizens since the confidence interval contained '1'. For those with permanent resident *citizenship status*, their odds of full-time (vs. not full-time) employment were 52% lower than for Canadian citizens. For those with *citizenship status*: other/not answered, their odds of full-time (vs. not full-time) employment were almost four times greater than for Canadian citizens. This was because the majority of IMGs in this category were in Canada under a work permit/visa requiring full-time employment Also, the confidence interval for the 'Permanent Resident' category was much narrower than for 'Other/not answered', showing it to be a more precise estimate. For the *first language spoken (is official language)* variable, the comparison of those whose first language was one of the official languages of Canada (e.g. English or French) versus the reference was not significant (*Table 40, Figure 15*). The same was true of those who did not answer versus the reference.

Table 40. Odds ratios for non-interacting terms in final model (N=4558)

Variable	**Odds ratio [95% confidence interval]**	**Interpretation** (odds of full-time employment)
Citizenship status		
Canadian Citizen	Reference	
Permanent Resident	0.474 [0.366, 0.614]	About ½ the odds
Temporary Resident	0.920 [0.600, 1.412]	No difference
Other/ not answered	3.786 [2.497, 5.740]	About 4x the odds
First language spoken (is official language)		
No	Reference	
Yes	1.173 [0.959, 1.467]	No difference
Not answered	1.016 [0.800, 1.300]	No difference

For the four significant interactions, odds ratio estimates were reported for each level of variable, holding the other variable(s) fixed at each respective level (*Tables 41, 42, 43, 44*, and *45*). For male IMGs, no difference was detected in the odds of full-time status by comparing any level of the *time from entry* variable and the 'less than one year' reference level for IMGs who came from North America or Western Europe (*Table 41*). There were differences detected in some levels of the *time from entry* variable and the reference level for IMGs who came from all other *regions of origin*. For instance, male IMGs from West Asia who have been in Canada 5-10 years have twice the odds of full-time status than male IMGs from West Asia who have been in Canada less than 1 year. Therefore, the longer a male IMG has been in Canada, the greater the odds of full-time status (for those cases which had significant odds ratios).

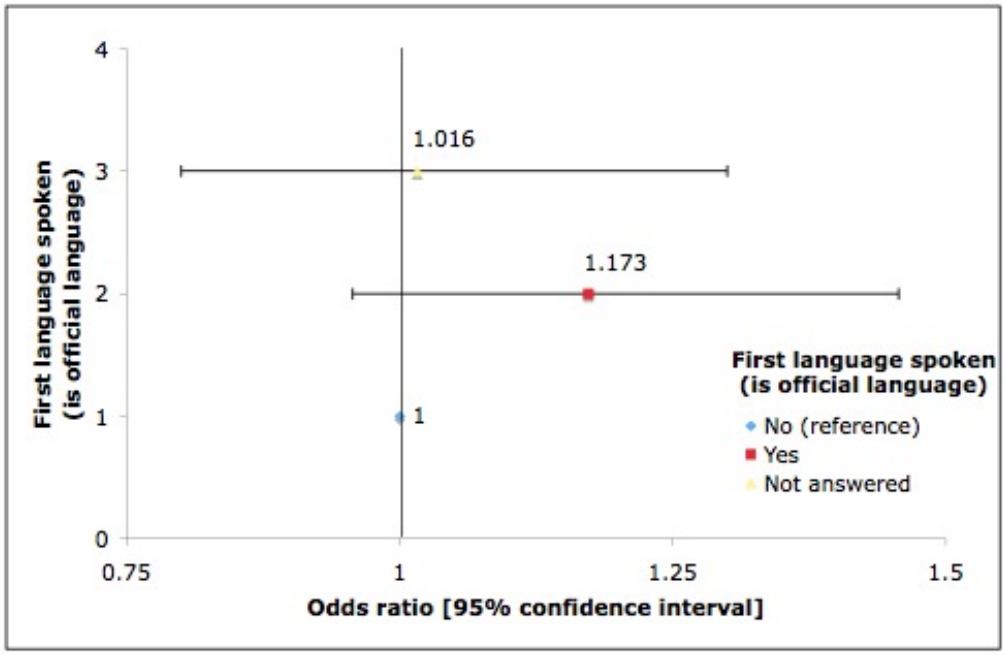

Figure 14. Odds ratios [95% confidence intervals] for first language spoken (is official language)

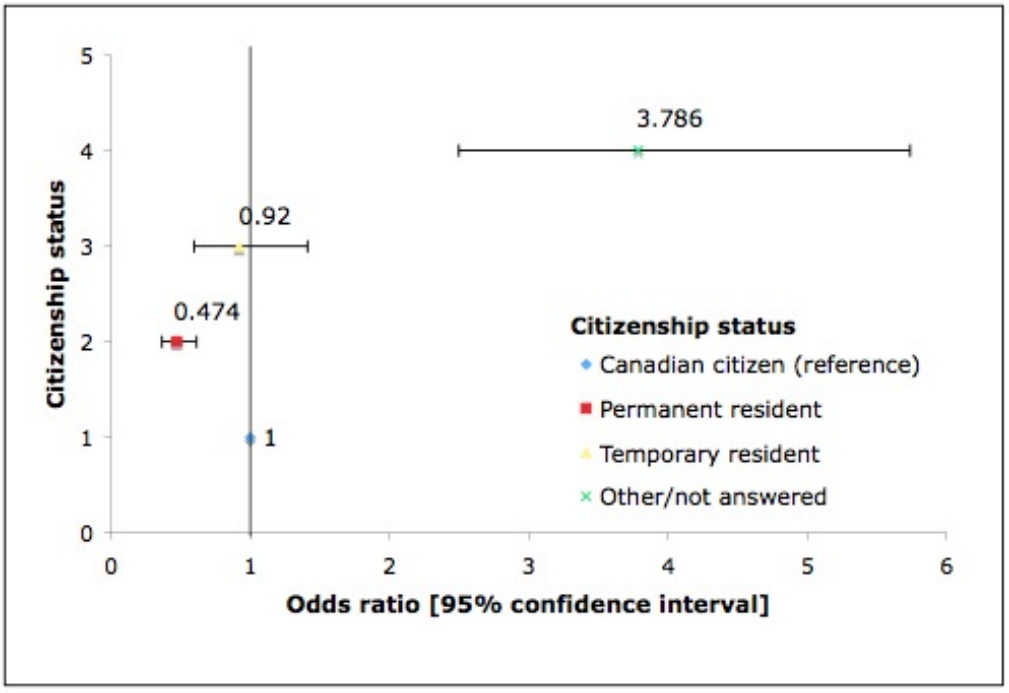

Figure 15. Odds ratios [95% confidence intervals] for citizenship status

Table 41. Interaction odds ratios for time from entry by region of origin for men (N=4558)

Variable **Time from entry**	**At Region of origin (category)**	**Odds Ratio**	**95% Confidence Interval**	**Interpretation** (odds of full-time status)
Less than 1 year		Reference		
1-5 years	North America,	1.493	[0.506, 4.405]	No difference
5-10 years	Western Europe	0.924	[0.146, 5.840]	No difference
Over 10 years		0.875	[0.250, 3.058]	No difference
1-5 years	Africa	2.364	[1.431, 3.906]	A little over 2x the
5-10 years		2.304	[1.061, 5.003]	odds
Over 10 years		1.984	[0.867, 4.545]	No difference
1-5 years	Caribbean, C/S	3.125	[1.675, 5.848]	About 3x the odds
5-10 years	America	0.625	[0.220, 1.776]	No difference
Over 10 years		0.842	[0.195, 3.636]	No difference
1-5 years	East Asia	2.041	[0.935, 4.444]	No difference
5-10 years		4.484	[1.941, 10.358]	About 4½x the odds
Over 10 years		6.711	[2.433, 18.519]	Over 6½x the odds
1-5 years	Eastern Europe	2.915	[1.447, 5.882]	About 3x the odds
5-10 years		3.224	[1.470, 7.071]	Over 3x the odds
Over 10 years		2.571	[1.054, 6.289]	Over 2½x the odds
1-5 years	South Asia	2.475	[1.730, 3.534]	About 2½x the odds
5-10 years		1.351	[0.822, 2.220]	No difference
Over 10 years		1.497	[0.820, 2.732]	No difference
1-5 years	Southeast Asia	4.237	[1.859, 9.709]	Over 4x the odds
5-10 years		5.474	[1.721, 17.41]	About 5½x the odds
Over 10 years		3.135	[0.922, 10.638]	No difference
1-5 years	West Asia	1.479	[0.912, 2.404]	About 1½x the odds
5-10 years		2.248	[1.222, 4.134]	Over 2x the odds
Over 10 years		1.770	[0.794, 3.953]	No difference

Similarly to men, IMGs who were women, also had greater the odds of full-time status (for those cases which had significant odds ratios) the longer they been in Canada (*Table 42*). Although, the odds ratios were different for women; and had generally more pronounced effects. Women from Africa who have been in Canada 5-10 years had three times the odds of full-time status compared to women from Africa who have been in Canada less than 1 year. In contrast, men had only two times the odds of full-time status for the same comparison.

Table 42. Interaction odds ratios for time from entry by region of origin for women (N=4558)

Variable **Time from entry**	**At Region of origin (category)**	**Odds Ratio**	**95% Confidence Interval**	**Interpretation** (odds of full-time status)
Less than 1 year		Reference		
1-5 years	North America,	1.057	[0.362, 3.086]	No difference
5-10 years	Western Europe	1.210	[0.193, 7.589]	No difference
Over 10 years		1.678	[0.471, 5.952]	No difference
1-5 years	Africa	1.675	[0.951, 2.950]	No difference
5-10 years		3.015	[1.340, 6.782]	About 3x the odds
Over 10 years		3.802	[1.603, 9.009]	Over 3½x the odds
1-5 years	Caribbean, C/S	2.217	[1.176, 4.184]	Over 2½x the odds
5-10 years	America	0.818	[0.281, 2.379]	No difference
Over 10 years		1.613	[0.366, 7.092]	No difference
1-5 years	East Asia	1.445	[0.656, 3.185]	No difference
5-10 years		5.869	[2.612, 13.187]	Over 5½x the odds
Over 10 years		12.821	[4.630, 35.714]	Over 12½x the odds
1-5 years	Eastern Europe	2.066	[1.025, 4.167]	About 2x the odds
5-10 years		4.219	[1.991, 8.942]	Over 4x the odds
Over 10 years		4.926	[2.092, 11.628]	Almost 5x the odds
1-5 years	South Asia	1.751	[1.168, 2.632]	Over 1½x the odds
5-10 years		1.769	[1.079, 2.898]	Over 1½x the odds
Over 10 years		2.865	[1.610, 5.102]	Over 2½x the odds
1-5 years	Southeast Asia	3.003	[1.307, 6.897]	About 3x the odds
5-10 years		7.165	[2.289, 22.429]	About 7x the odds
Over 10 years		6.024	[1.802, 20.000]	About 6x the odds
1-5 years	West Asia	1.049	[0.600, 1.835]	No difference
5-10 years		2.942	[1.526, 5.672]	Almost 3x the odds
Over 10 years		3.390	[1.453, 7.937]	Over 3x the odds

By comparing an *age* group to the reference group (30-39 years) for male IMGs, for a given *region of origin*, a pattern emerges (*Table 43*). Most of these comparisons yield non-significant odds ratios indicating that there was no difference between an *age* group and the reference level. For those odds ratios that were significant, male IMGs under 30 usually have less than or equal to 50% of the odds of full-time status as male IMGs who are 30-39 years old.

Table 43. Interaction odds ratios for age by region of origin for men (N=4558)

Variable **Age (years)**	**At Region of origin (category)**	**Odds Ratio**	**95% Confidence Interval**	**Interpretation** (odds of full-time status)
30-39		Reference		
Under 30	North America,	0.169	[0.052, 0.553]	About $^1/_6$ the odds
40-49	Western Europe	0.422	[0.126, 1.411]	No difference
50 and over		0.143	[0.015, 1.401]	No difference
Under 30	Africa	0.352	[0.155, 0.799]	Over $^1/_3$ the odds
40-49		0.98	[0.589, 1.628]	No difference
50 and over		0.450	[0.216, 0.934]	Almost ½ the odds
Under 30	Caribbean, C/S	1.089	[0.511, 2.318]	No difference
40-49	America	0.950	[0.470, 1.921]	No difference
50 and over		0.579	[0.196, 1.709]	No difference
Under 30	East Asia	0.799	[0.230, 2.772]	No difference
40-49		0.578	[0.313, 1.066]	No difference
50 and over		0.119	[0.034, 0.413]	Over $^1/_{10}$ the odds
Under 30	Eastern Europe	0.828	[0.362, 1.892]	No difference
40-49		0.922	[0.514, 1.653]	No difference
50 and over		0.782	[0.328, 1.862]	No difference
Under 30	South Asia	0.356	[0.201, 0.628]	Over $^1/_3$ the odds
40-49		1.172	[0.822, 1.671]	No difference
50 and over		1.124	[0.717, 1.761]	No difference
Under 30	Southeast Asia	0.495	[0.117, 2.086]	No difference
40-49		0.541	[0.245, 1.192]	No difference
50 and over		0.223	[0.057, 0.871]	Over $^1/_5$ the odds
Under 30	West Asia	0.435	[0.204, 0.927]	Almost ½ the odds
40-49		0.534	[0.336, 0.849]	Over ½ the odds
50 and over		0.566	[0.276, 1.161]	No difference

Similarly, by comparing an *age* group to the reference group (30-39 years) for female IMGs, for a given *region of origin*, a pattern is visible (*Table 44*). Most of these comparisons yield non-significant odds ratios indicating that there was no difference between an *age* group and the reference level. Female IMGs who were Under 30 from North America, Western Europe had only a third of the odds of full-time status as female IMGs who were 30-39 years old from North America, Western Europe. East Asian women 50 and over had one fifth of the odds of full-time status as East Asian women 30-39 years old. Both South Asian women who were 40-49 years old and 50 and over had twice the odds of full-time employment compared to South Asian women who were 30-39 years old. It is surprising and interesting that only these four comparisons proved significant for women.

Table 44. Interaction odds ratios for age by region of origin for women (N=4558)

Variable **Age (years)**	**At Region of origin (category)**	**Odds Ratio**	**95% Confidence Interval**	**Interpretation** (odds of full-time status)
30-39		Reference		
Under 30	North America,	0.305	[0.096, 0.970]	About $^1/_3$ the odds
40-49	Western Europe	0.734	[0.220, 2.446]	No difference
50 and over		0.250	[0.025, 2.538]	No difference
Under 30	Africa	0.636	[0.266, 1.524]	No difference
40-49		1.704	[0.978, 2.968]	No difference
50 and over		0.788	[0.342, 1.812]	No difference
Under 30	Caribbean, C/S	1.966	[0.945, 4.088]	No difference
40-49	America	1.652	[0.806, 3.385]	No difference
50 and over		1.014	[0.320, 3.215]	No difference
Under 30	East Asia	1.443	[0.430, 4.845]	No difference
40-49		1.005	[0.549, 1.838]	No difference
50 and over		0.208	[0.059, 0.735]	About $^1/_5$ the odds
Under 30	Eastern Europe	1.495	[0.673, 3.321]	No difference
40-49		1.603	[0.915, 2.809]	No difference
50 and over		1.370	[0.604, 3.106]	No difference
Under 30	South Asia	0.642	[0.374, 1.104]	No difference
40-49		2.038	[1.404, 2.958]	About 2x the odds
50 and over		1.969	[1.178, 3.289]	About 2x the odds
Under 30	Southeast Asia	0.894	[0.215, 3.706]	No difference
40-49		0.941	[0.426, 2.079]	No difference
50 and over		0.391	[0.100, 1.536]	No difference
Under 30	West Asia	0.786	[0.355, 1.742]	No difference
40-49		0.929	[0.552, 1.564]	No difference
50 and over		0.992	[0.451, 2.179]	No difference

By examining the odds ratios for the interaction of *gender* and *age* by *time from entry*, a few cases emerge with significant patterns (*Table 45*). Men of any *age* group for most *times from entry* saw no difference in their odds of full-time employment than women of the same *age* group and *time from entry*. There were some significant cases such as men, under 30 who have been in Canada for 1-5 years had over twice the odds of full-time status as women, under 30 who have been in Canada for the same amount of time. In any case that was significant, men had between one and a half to three times the odds of full-time employment as women (of a particular age and who has been in Canada a certain time).

Table 45. Interaction odds ratios for gender and age by time from entry (N=4558)

Variables Gender, Age (years)	**At Time from entry (category)**	**Odds Ratio**	**95% Confidence Interval**	**Interpretation** (odds of full-time status)
Women		Ref.		
Men, Under 30	Less than 1 year	1.564	[0.931, 2.628]	No difference
	1-5 years	2.209	[1.296, 3.763]	Over 2x the odds
	5-10 years	1.185	[0.636, 2.207]	No difference
	Over 10 years	0.800	[0.405, 1.579]	No difference
Men, 30-39	Less than 1 year	2.832	[2.018, 3.975]	Almost 3x the odds
	1-5 years	4.000	[2.865, 5.583]	4x the odds
	5-10 years	2.146	[1.402, 3.283]	Over 2x the odds
	Over 10 years	1.448	[0.843, 2.487]	No difference
Men, 40-49	Less than 1 year	1.634	[1.129, 2.364]	Over 1½x the odds
	1-5 years	2.307	[1.609, 3.307]	Over 2x the odds
	5-10 years	1.238	[0.817, 1.875]	No difference
	Over 10 years	0.835	[0.503, 1.387]	No difference
Men, 50 and over	Less than 1 year	1.708	[0.975, 2.992]	No difference
	1-5 years	2.412	[1.391, 4.180]	Almost 2½x odds
	5-10 years	1.294	[0.726, 2.306]	No difference
	Over 10 years	0.873	[0.468, 1.630]	No difference

5.4. Baseline employment status

5.4.1. Description of the cross-sectional data

Baseline employment status was one of questions IMGs had to respond to on the registration form for the Access Centre. The four categories to choose from included: full-time, part-time, casual and not employed. Inclusion/exclusion criteria were applied to each category. Excluded from this analysis were: those who did not specify their baseline employment status (N=1954).

For each category (e.g. full-time, part-time etc.), excluded were: those who did not specify their age or gender or those who are not living in Ontario, Canada, and those who registered before Jan. 1, 2007. The figures also included a breakdown, after exclusions of each category by total population (N=4638), total IMG users (N=2709) and total IMG non-users (N=1929).

For full-time employment status, there were almost 1000 inclusions. Across various explanatory variables such as *region of origin*, which has 8 categories, this was a large

enough sample size to have a sufficient number of IMGs in each cell to avoid model conversion problems.

For part-time employment status, there were almost 500 inclusions. This allowed for this employment status to have enough IMGs per variable category (per cell) to allow for the models to be run (*Figure 16*).

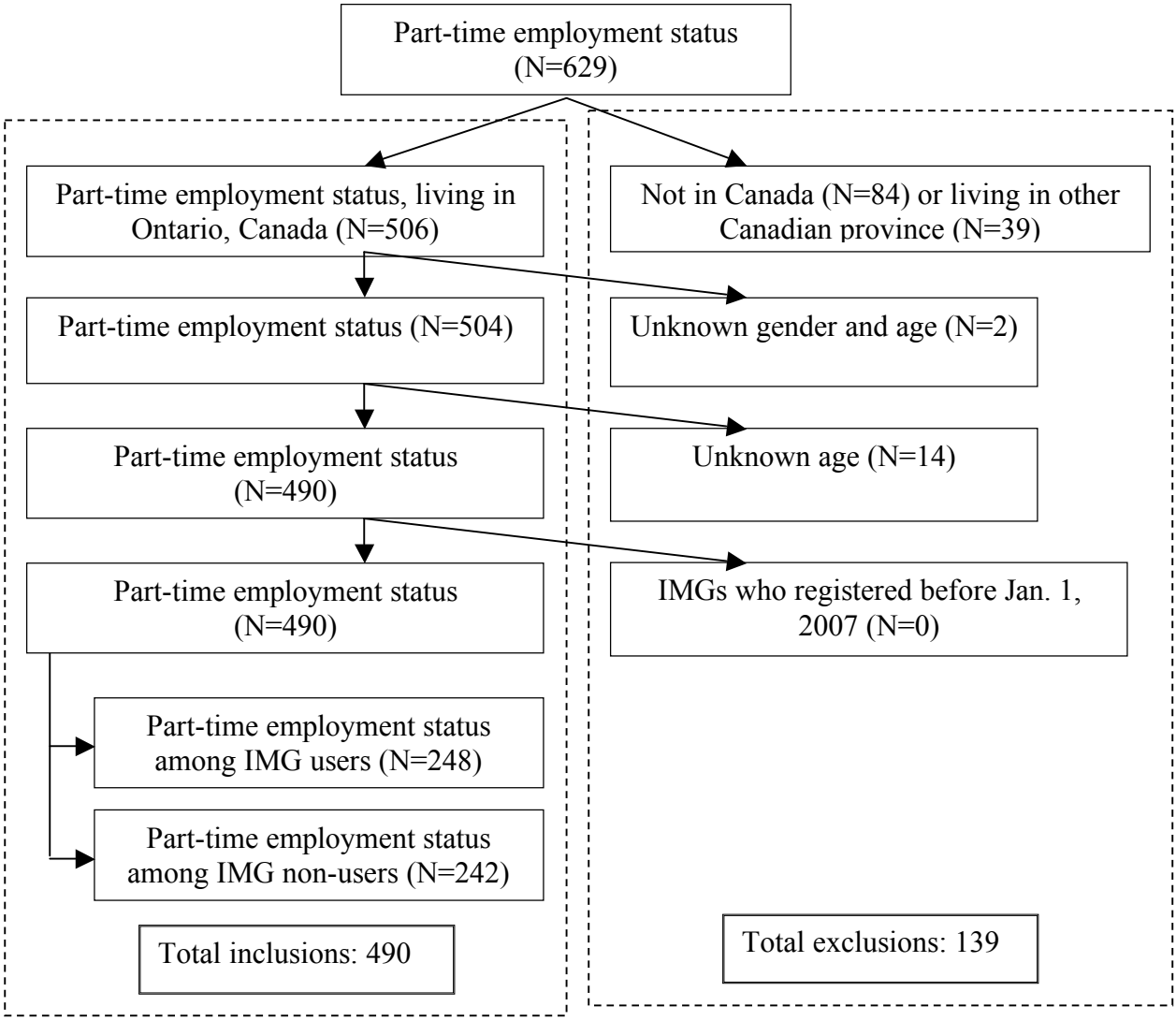

Figure 16. Part-time employment status inclusion/ exclusion flow chart

For casual employment status, after exclusions there were only 161 in this category of baseline employment status. As this was a very small number of IMGs, it was best to merge this category with the part-time employment status, which gives a total of 651 IMGs in the new category labeled 'part-time/casual' (*Figure 17*).

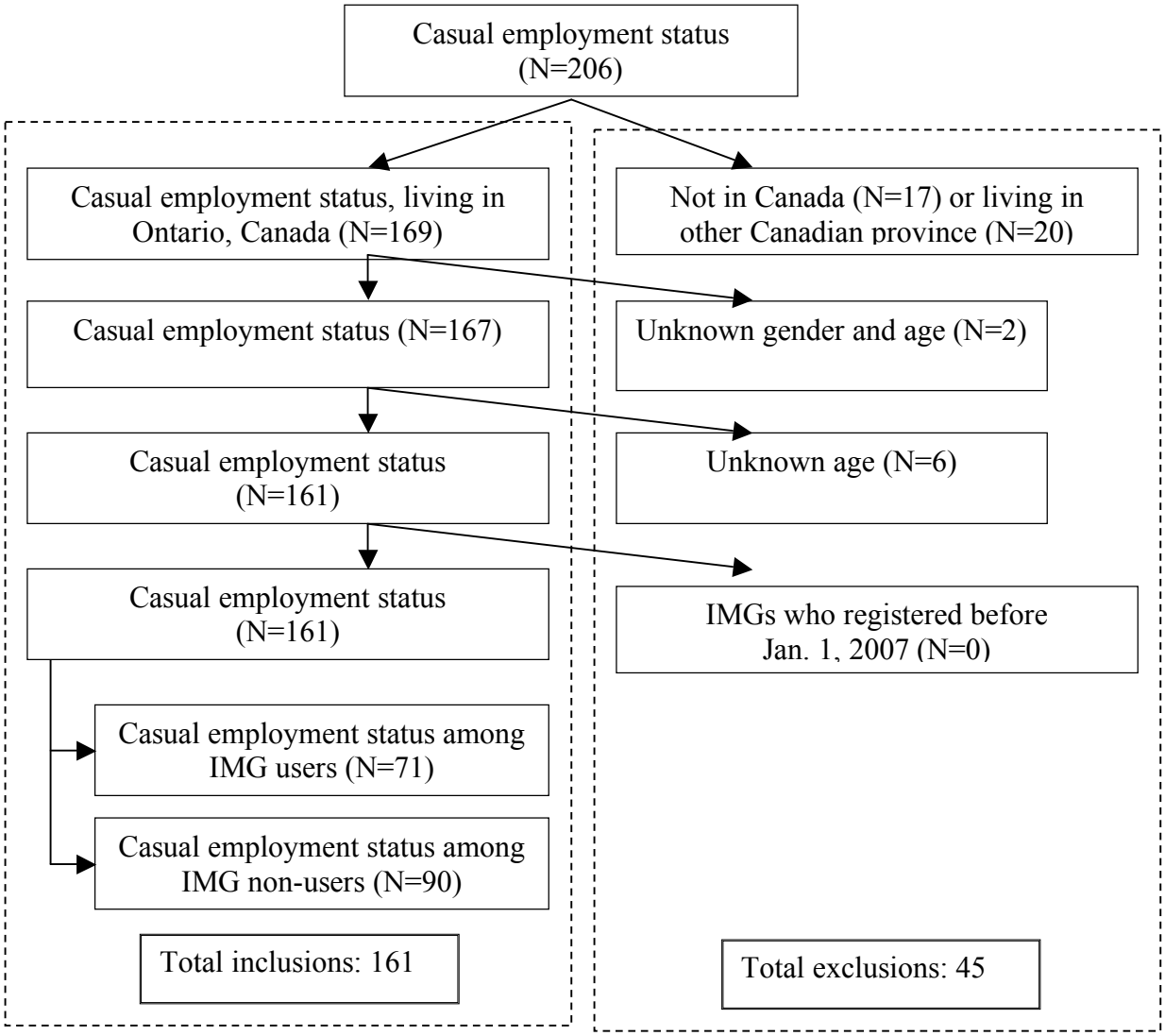

Figure 17. Casual employment status inclusion/ exclusion flow chart

For the IMGs in the not employed category, there were almost 3000 inclusions, which allowed for more than enough IMGs per cell of the explanatory variables for the model to be run (*Figure 18*).

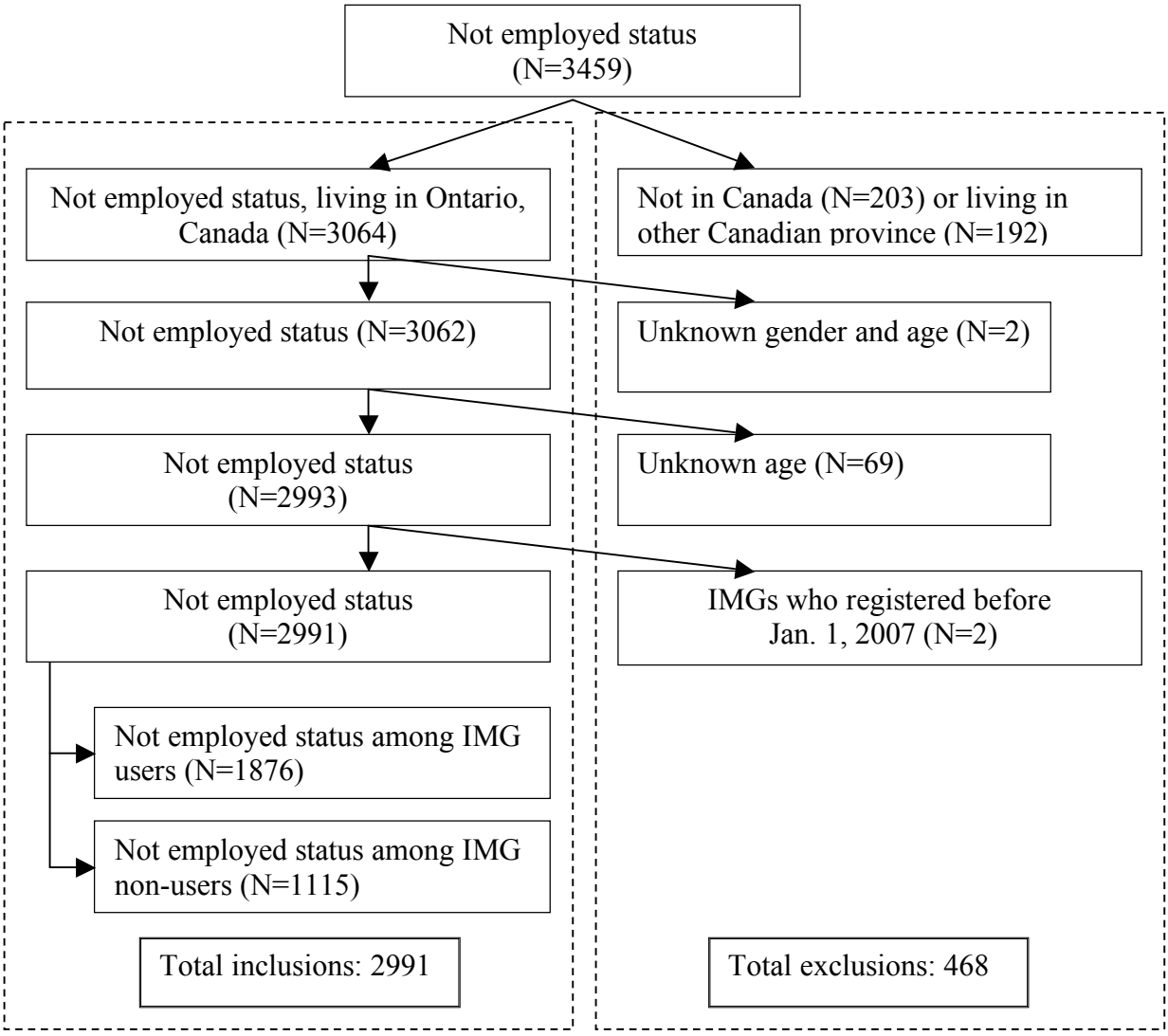

Figure 18. Not employed status inclusion/ exclusion flow chart

5.4.2. Model development

The initial selection of covariates was accomplished in the same way as in the previous section. The same ten variables that were selected for the baseline full-time status analysis were included (section 5.2.2.). It was also necessary to verify that there were low percent missing data across variables by baseline employment status categories.

Univariate analysis of baseline employment status by each variable level was performed. Characteristics of IMGs who were in full-time, part-time/casual or no employment, at the time of registration at the Access Centre, were described (*Table 46*).

Table 46. Characteristics of IMGs by baseline employment status (N=4638)

Characteristic	Total		Full-time		Part-time/ casual		Not employed		p
	n	%	n	%	n	%	n	%	
Total	4638	100.0	996	100.0	651	100.0	2991	100.0	
Gender									<0.0001
Women	2375	51.2	428	43.0	332	51.0	1615	54.0	
Men	2263	48.8	568	57.1	319	49.0	1376	46.0	
Age									<0.0001
Under 30	728	15.7	93	9.3	94	14.4	541	18.1	
30-39	1925	41.5	413	41.5	264	40.6	1248	41.7	
40-49	1476	31.8	376	37.8	211	32.4	889	29.7	
50 and over	509	11.0	114	11.4	82	12.6	313	10.5	
City of residence									0.0915
Town	35	0.8	13	1.3	8	1.2	14	0.5	
Small City	88	1.9	22	2.2	13	2.0	53	1.8	
Medium City	99	2.1	24	2.4	15	2.3	60	2.0	
Large City	4411	95.2	936	94.0	615	94.5	2860	95.6	
Urban status									0.0636
No	222	4.8	59	5.9	36	5.5	127	4.2	
Yes	4411	95.2	936	94.1	615	94.5	2860	95.6	
Region of origin									<0.0001
North America, Western Europe	133	2.9	39	3.9	19	2.9	73	2.4	
Africa	589	12.7	121	12.1	78	12.0	390	13.0	
Caribbean, C/S America	329	7.1	88	8.8	55	8.4	186	6.2	
East Asia	329	7.1	132	13.3	48	7.4	149	5.0	
Eastern Europe	391	8.4	126	12.7	75	11.5	190	6.3	
South Asia	1706	36.8	298	29.9	233	35.8	1175	39.3	
Southeast Asia	225	4.9	59	5.9	30	4.6	136	4.5	
West Asia	917	19.8	131	13.2	110	16.9	676	22.6	
Not answered	19	0.4	2	0.2	3	0.5	14	0.5	
Citizenship status									<0.0001
Canadian Citizen	1144	24.7	406	40.8	258	39.6	480	16.0	
Permanent Resident	3089	66.6	440	44.2	360	55.3	2289	76.5	
Temporary Resident	231	5.0	54	5.4	17	2.6	160	5.3	
Other/ not answ.	174	3.7	96	9.6	16	2.5	62	2.1	
Time from entry									<0.0001
Less than 1 Year	2134	46.0	288	28.9	149	22.9	1697	56.7	
1-5 Years	1451	31.3	322	32.3	264	40.6	865	28.9	
5-10 Years	636	13.7	219	22.0	148	22.7	269	9.0	
Over 10 Years	359	7.7	147	14.8	81	12.4	131	4.4	
Not answered	58	1.3	20	2.0	9	1.4	29	1.0	

Characteristic	Total		Full-time		Part-time/ casual		Not employed		p
	n	%	n	%	n	%	n	%	
Total	4638	100.0	996	100.0	651	100.0	2991	100.0	
First language spoken (is official language)									<0.0001
No	3349	72.2	691	69.4	460	70.7	2198	73.5	
Yes	610	13.2	124	12.4	70	10.7	416	13.9	
Not answered	679	14.6	181	18.2	121	18.6	377	12.6	
Region of education									<0.0001
North America, Western Europe	124	2.7	38	3.8	20	3.1	66	2.2	
Africa	576	12.4	115	11.5	74	11.4	387	12.9	
Caribbean, C/S America	384	8.3	100	10.0	63	9.7	221	7.4	
East Asia	327	7.0	129	13.0	47	7.2	151	5.0	
Eastern Europe	569	12.3	156	15.7	97	14.9	316	10.6	
South Asia	1580	34.1	287	28.8	217	33.3	1076	36.0	
Southeast Asia	225	4.8	56	5.6	30	4.6	139	4.6	
West Asia	844	18.2	112	11.2	103	15.8	629	21.0	
Not answered	9	0.2	3	0.3	0	0	6	0.2	
Time from graduation									<0.0001
Under 1 Year	253	5.5	32	3.2	24	3.7	197	6.6	
1-5 Years	640	13.8	106	10.6	85	13.0	449	15.0	
6-10 Years	872	18.8	168	16.9	111	17.0	593	19.8	
11-15 Years	834	18.0	185	18.6	105	16.1	544	18.2	
16-20 Years	594	12.8	142	14.3	89	13.7	363	12.1	
21-25 Years	452	9.8	120	12.0	66	10.1	266	8.9	
Over 25 Years	399	7.3	78	7.8	54	8.3	207	6.9	
Not answered	654	14.1	165	16.6	117	18.0	372	12.4	

Since the characteristics of IMGs who were in full-time employment having already been explained (*Table 6*), here, especially the characteristics of IMGs who were in part-time/casual or no employment are detailed (*Table 46*). While there was a greater percent of IMGs who were men than women in full-time employment, there were greater percentages of IMGs who were women as opposed to men in part-time/casual (51%) or no employment (54%). In terms of *age* groups, there were proportionally more, younger, IMGs in part-time/casual or no employment. The pattern for *city type* and *urban status* was the great majority of IMGs were living in large cities no matter their employment status. The pattern for *region of origin* was fairly consistent across full-time, part-time/casual and no employment where the greatest numbers of IMGs were from South Asia and the least were from North America, Western Europe. There were proportionately more IMGs who were

permanent residents who were in part-time/casual (55%) or no employment (76%) compared to permanent residents making up only 40% of IMGs in full-time employment. The distribution of the *times from entry* for IMGs in part-time/casual employment was similar to IMGs in full-time employment. In contrast, 57% of IMGs not employed were in Canada for less than 1 year. There were greater percentages of IMGs whose first language was not English or French in part-time/casual (71%) and no employment (74%) compared to those in full-time employment (69%) as a share of those categories of employment status. The patterns for *region of education* across full-time, part-time/casual and not employed categories were very similar, with greater percentages of IMGs who completed their medical education in South Asia and West Asia being not being employed (36% and 21% respectively) compared to full-time employment (34% and 18% respectively). Similarly, the patterns for *time from graduation* were also very similar for IMGs across employment status categories.

Fisher's exact tests or chi-square tests showed whether there was a difference between levels of each variable and *baseline employment status*. *City type* (p=0.0915) and *urban status* (p=0.0636) were not included in further analyses as they had non-significant p-values. Missing values for *region of origin* (only 19 IMGs) and *region of education* (only 9 IMGs) were excluded to avoid low cell counts. Within the variables: *time from entry, first language spoken (is official language)* and *time from graduation*, a category for those who did not answer was included. For those who did not answer the citizenship status question, the 'not answered' category was combined with the 'other' category. Since the 'not answered' category of the variable *time from entry* possessed only 58 entries, this group of IMGs was removed to avoid low cell counts in some levels of that variable; for example, cross-tabulating *time from entry* with *region of origin* gave many low cell counts (less than 5 per category).

A cumulative logistic regression (proportional odds model) was run with three categories of baseline employment status: full-time, part-time/casual and not employed. Stepwise selection using SAS software with an entry p-value of 0.25 and a stay p-value of 0.05, and testing for all two-way interactions yielded the following covariates entered and retained. Variables included and excluded are described (*Table 47*).

Table 47. Variables/interactions included an excluded by stepwise selection

Variables/interactions included		**Variables excluded**
1. *Citizenship status*	1. Interaction of *gender* and *citizenship status*	1. *First language spoken (is official language)*
2. *Region of origin*	2. Interaction of *age* and *citizenship status*	4. *Time from graduation*
3. *Gender*	3. Interaction of *gender* and *age*	5. *Region of education*
4. *Time from entry*	4. Interaction of *region of origin* and *gender*	
5. *Age*		

It was not possible to test for all three-way interactions simultaneously due to lack of memory as a result of the amount of computation involved. However, since *gender* was interacting with both *citizenship status* and *region of origin,* then this three-way interaction was tested individually. The p-value for the interaction of these three variables for the 'type 3 tests of effect' gave p=0.3703, which was not significant. Therefore, the suspected three-way interaction was not included in the model.

It was also important to keep *first language spoken (is official language)* in the model, despite it not being significant to stay in the model. It had a p-value around 0.25, nonetheless. Since *time from graduation* had a p-value around 0.95, it was not useful to keep it in the model.

Collinearity was previously detected by Spearman rank correlation coefficients (*Table 12)*. The same conclusions were drawn as before to include only either *region of origin* or *region of education* in the model due to high collinearity. Similar to previous logistic regression analyses for full-time employment status, proportional odds models were created and *Type 3 Analysis of Effects* compared for each variable, including interaction terms detected by stepwise selection. Since stepwise selection selected for *region of origin*, and by comparing the models, *region of education* was not significant when included alongside *region of origin*, it was decided that only *region of origin* would be included. In likewise manner, only a model including both IMG users and non-users as a single group at registration was created. This was because only after registration did IMGs decide on whether they would use the variety of services offered by the Access Centre or to not become users and to not use the services beyond initial registration.

5.4.3. Assessment of the model

The cumulative logit or proportional odds model estimated one equation over all ordered levels of the dependent variable, *baseline employment status* (full-time, part-time/casual or not employed as three ordered categories). In fact, this sort of model made the proportional odds assumption, which was that the curves of the various cumulative logits were parallel to each other.

The *score test* was used in the SAS program to test this assumption and the p-value was highly significant (<0.0001), meaning this assumption in the model failed. Therefore, it was best to run a, less restrictive, multinomial model to compare 'full-time' to 'part-time/casual' and to compare 'full-time' to 'not employed' employment categories instead of summing over the lower ordered categories as in the proportional odds model.

Stepwise selection was once again applied and tested for all two-way interactions. Quasi-complete separation[43] was detected when the interaction of *citizenship status* and *time from entry*, was entered. This may have been due to very low cell counts in three cells all having less than 5 IMGs. It was, however, not possible to collapse further the *citizenship status* or *time from entry* categories. In any case, this interaction was not found to be significant. Stepwise selection using SAS software with an entry p-value of 0.25 and a stay p-value of 0.05, and testing for all two-way interactions yielded the following covariates entered and retained (*Table 48*).

Therefore, the stepwise selection for the multinomial model, compared to the proportional odds model found the same set of covariates significant, with the exception of two of the four interaction terms, which were not found to be significant. The two interactions significant in the proportional odds model, but not the multinomial model were: the interaction of *gender* and *citizenship status* and the interaction of *gender* and *age*.

[43] Quasi-complete separation of points suggests the data are not 'separable' and yield nonunique infinite estimates. To address this, the model can be changed; a different likelihood method and/or exact computations can be used. In this case, changing the model by removing 'low cell count' categories alleviated the problem.

Table 48. Variables/interactions included an excluded by stepwise selection

Variables/interactions included		Variables excluded
1. *Citizenship status*	1. Interaction of *age* and *citizenship status*	1. *First language spoken (is official language)*
2. *Region of origin*	2. Interaction of *region of origin* and *gender*	2. *Time from graduation*
3. *Gender*		3. *Region of education*
4. *Time from entry*		
5. *Age*		

The likelihood ratio test (LRT) was performed (*Table 49*). *First language spoken (is official language)* variable was kept in the model, as before, to account for unobserved heterogeneity.

Table 49. Summary of LRT results (N=4650)

Variable(s) taken out of model	df	chi-square	Crit. value	p	Interpretation
Gender - Interaction (gender, region of origin)	2	131.846	5.99	<0.001	Keep variable and its interaction
Age - Interaction (age, citizenship status)	2	73.545	5.99	<0.001	
Region of origin - Interaction (gender, region of origin)	2	152.262	5.99	<0.001	
Citizenship status - Interaction (age, citizenship status)	2	226.411	5.99	<0.001	
Time from entry	1	193.908	3.84	<0.001	
First language spoken (is official language)	1	10.497	3.84	0.15	Discard first language spoken

The multinomial model was also checked through regression diagnostics. Both 'full-time employment status vs. not employed' and 'part-time/casual employment status vs. not employed' comparisons were assessed, but since regression diagnostics were not available via the multinomial model directly, a logistic regression model was created separately for each comparison.

For the 'full-time employment status vs. not employed' model, the sample size was reduced to 3921 (including only IMGs with full-time employment and IMGs not employed),

while for the 'part-time/casual employment status vs. not employed' model, the sample size was reduced to 3678 (including only IMGs with part-time/casual employment and IMGs not employed). Each multivariable logistic regression model produced diagnostics from which outliers could be detected. The full multinomial model was then run with and without the outliers to see if they would affect parameter estimates. More goodness-of-fit measures were also available for each separate multivariable logistic regression, and were presented.

For the 'full-time employment status vs. not employed' model, in each figure a blue circle labeled '0' signified 'not employed' and a blue '+' signified 'full-time employment'. The Hosmer-Lemeshow test outputted a chi-square of 9.5194 and a p-value of 0.3004, and gave a rough impression of good model fit. The c-statistic or area under the curve (AUC) was 0.777, which pointed to the model's acceptable discrimination. On the Pearson and Deviance graphs, there did not appear to be any outlying points (*Figure 10*). The Leverage, CI Displacement C, CI Displacement CBAR graphs showed one clear outlying point (*Figures 19 & 20*).

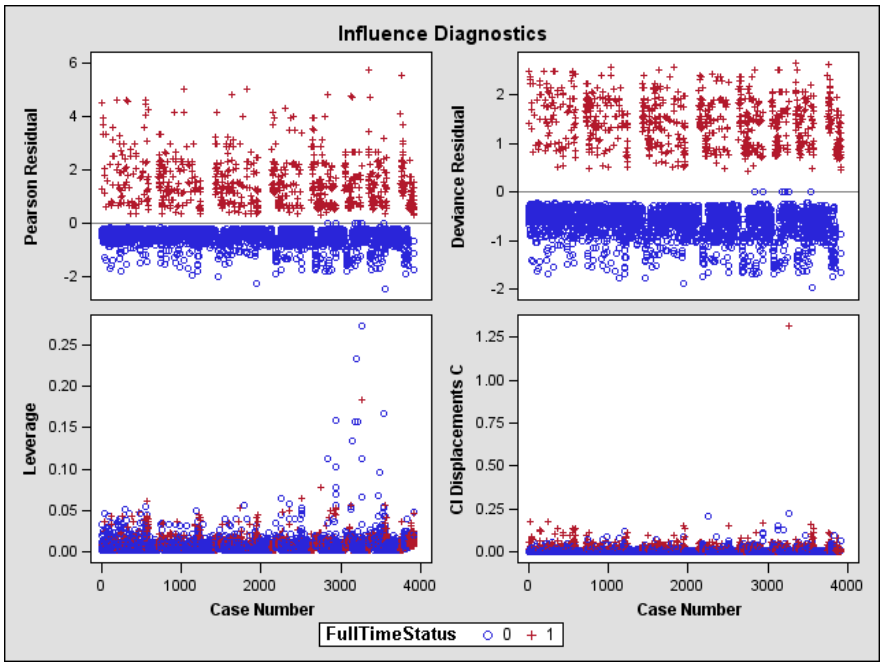

Figure 19. Influence diagnostics I (N=3921)

The Chi-square Deletion Difference and Deviance Deletion Difference also did not show any major outlying points (*Figure 20*).

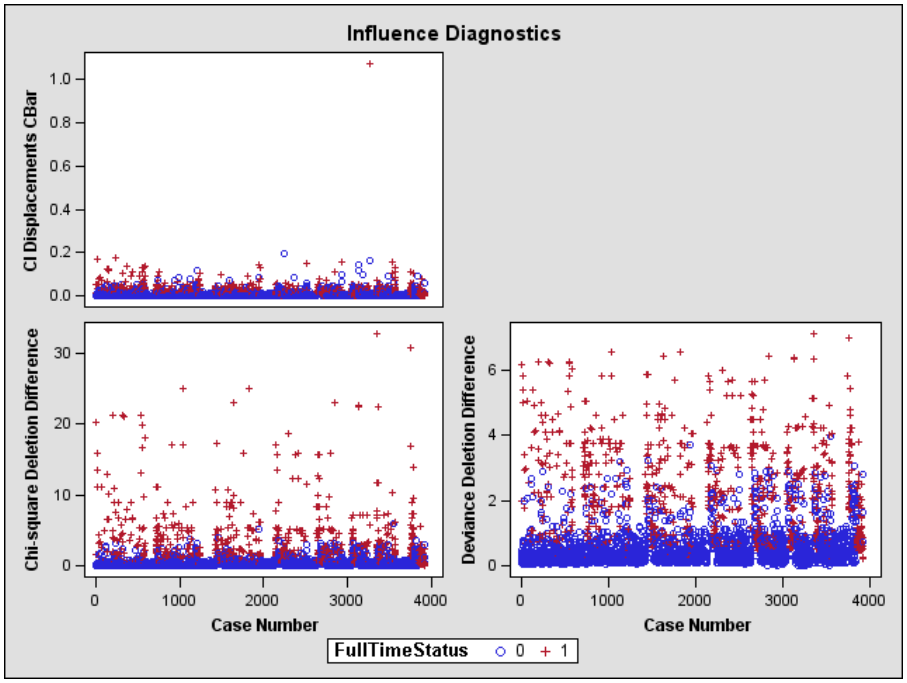

Figure 20. Influence diagnostics II (N=3921)

The outlier identified by influence diagnostics was observation (case number) 3260. A table showed the values of each covariate of interest for the purported outlier (*Table 50*).

Table 50. Characteristics of outlier detected by influence diagnostics

Obs. number	**Entry**	**Full-time status**	**Gender**	**Age**	**Region of origin**	**Citizenship status**	**First language spoken**	**Time from entry**
3206	AC-07091	Yes	Female	50 and over	Eastern Europe	Other/not answered	Not official language	1-5 years

By removing observation number 3260, the parameter estimates remained essentially the same between the full multinomial model with and without the outlier, with the exception of the coefficient (parameter estimate) of the interaction of *age* and *citizenship status* at *age*= 50 and over, *citizenship status*= other/not answered, and model comparison= full-time vs. not employed, changing by about 11 units. It was decided that this observation could be removed to improve the fit of the model.

The predicted probability diagnostics included the: chi-square deletion difference, the

deviance deletion difference, the *CI displacements C* and the leverage plots. The *CI displacement C* plot showed the outlier that was previously removed most clearly (*Figure 21*).

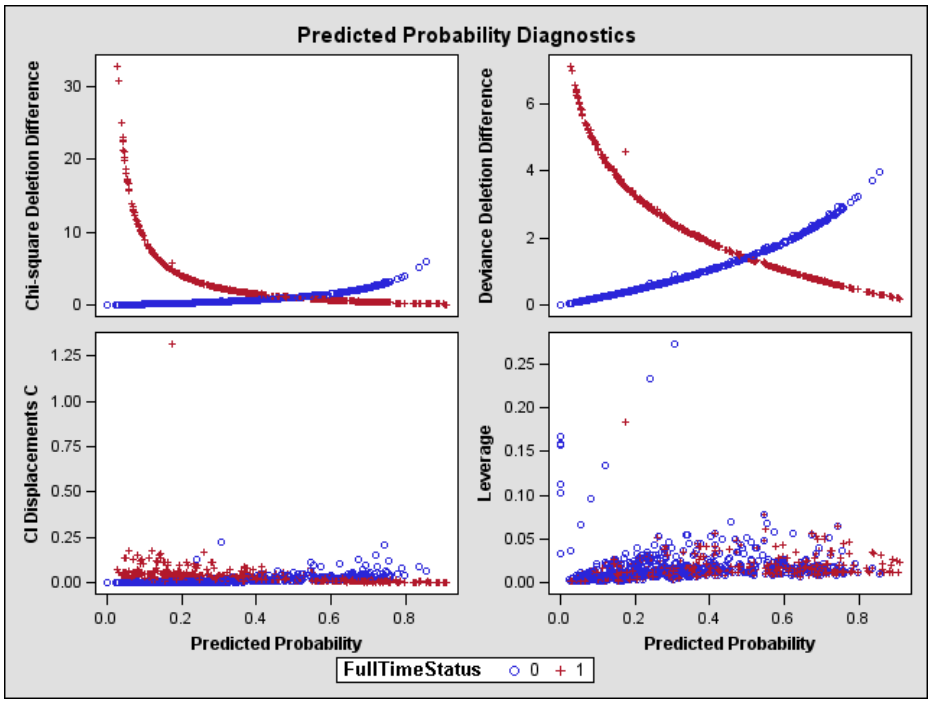

Figure 21. Predicted probability diagnostics (N=3921)

For the 'part-time/casual vs. not employed' employment status model, in each figure a blue circle labeled '0' signified 'not employed' and a blue '+' signified 'part-time/casual employment'. The Hosmer-Lemeshow test outputted a chi-square of 8.4192 and a p-value of 0.3936, and gave a rough impression of a good fit. The c-statistic or area under the curve (AUC) was 0.740, which pointed to the model's acceptable discrimination. On the *Pearson* and *Deviance* graphs, there did not appear to be any outlying points (*Figure 22*).

The Leverage, CI Displacement C, CI Displacement CBAR graphs showed three points (*Figures 22 & 23*). These were identified to be observation or case numbers 2974, 2907 and 2944. The Chi-square Deletion Difference and Deviance Deletion Difference showed two outlying points (*Figure 23*), namely observation numbers 1822 and 2816.

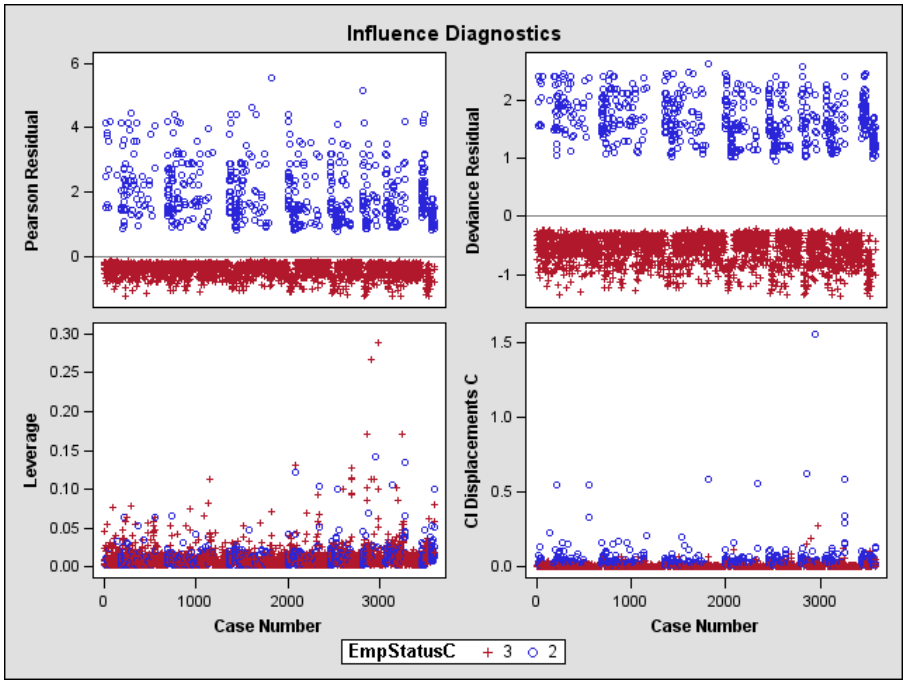

Figure 22. Influence diagnostics I (N=3588)

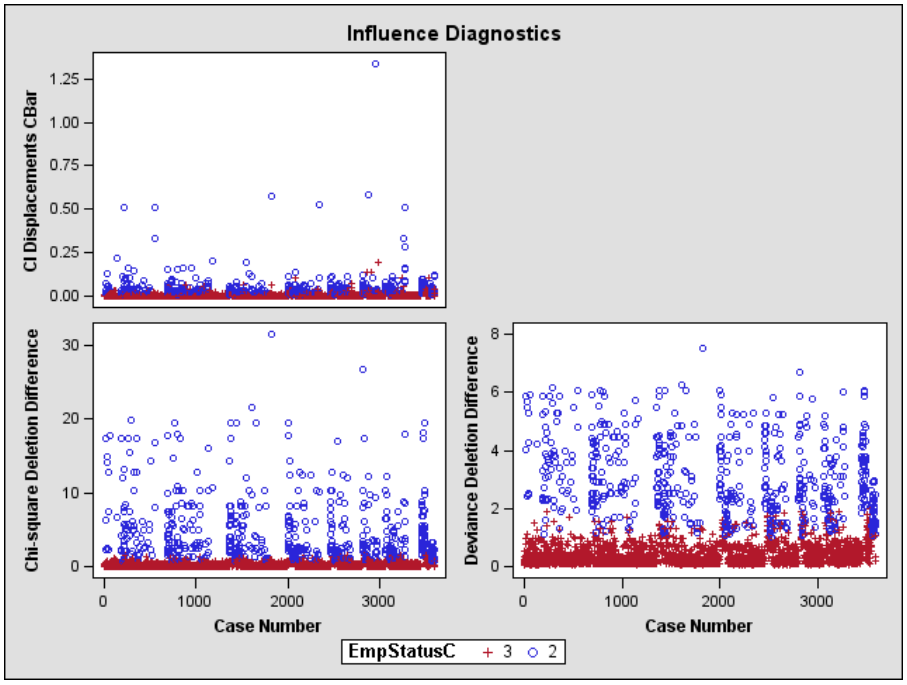

Figure 23. Influence diagnostics II (N=3588)

A table showed the values of each covariate of interest for the purported outliers (*Table 51*).

Table 51. Characteristics of outlier detected by influence diagnostics

Obs. no.	Entry	Full-time status	Gender	Age (yrs.)	Region of origin	Citizen-ship status	First language spoken	Time from entry
1822	070419/ Sala	No	Female	40-49	West Asia	Temporary resident	Not answered	Less than 1 year
2816	080125/ ALNA	No	Female	40-49	West Asia	Permanent resident	Official language	Less than 1 year
2907	AC-09221	No	Male	50 and over	Africa	Other/not answered	Not official language	5-10 years
2944	AC-31729	No	Male	50 and over	North America, Western Europe	Other/not answered	Not official language	Less than 1 year
2974	080212/ Chiq	No	Male	50 and over	Caribbean, C/S America	Other/not answered	Not official language	5-19 years

By removing the outliers, the parameter estimates remained essentially the same between the full multinomial model with and without the outlier, changing up to 1 unit. The exception to this was the term for the interaction of *age* and *citizenship status* at *age*= 50 and over, *citizenship status*= other/not answered, and model comparison= full-time vs. not employed, which changed by about 11 units. It was decided that these observations could be removed to improve the fit of the model.

The predicted probability diagnostics included the: chi-square deletion difference, the deviance deletion difference, the CI displacements C and the leverage plots (*Figure 24*). Some of the outliers were visible on these plots.

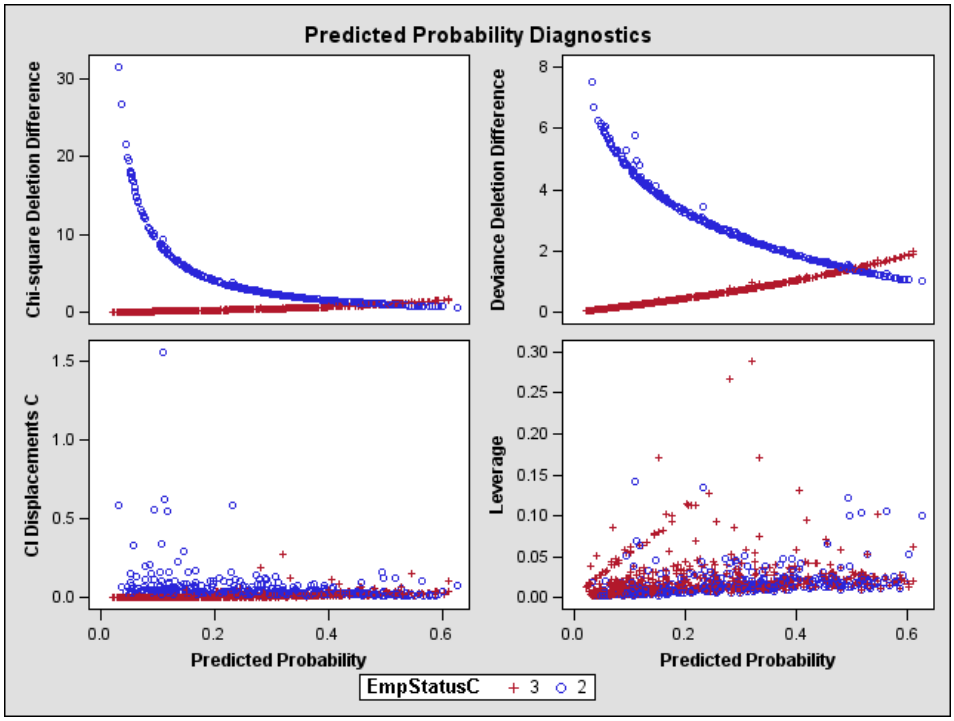

Figure 24. Predicted probability diagnostics (N=3588)

5.4.4. Final model presentation

After describing the cross-sectional data by baseline employment status category; developing the model through initial selection of covariates, univariate analysis, stepwise selection, collinearity checks, comparing models; and finally assessing the model through goodness-of-fit and regression diagnostics, a final model was reported. The final set of covariates and interactions in the multinomial model were the following (*Table 52*).

Table 52. Variables/interactions included

Variables/interactions included	
1. Citizenship status *2. Region of origin* *3. Gender* *4. Time from entry* *5. Age* *6. First language spoken (is official language)*	1. Interaction of *age* and *citizenship status* 2. Interaction of *gender* and *region of origin*

These regressor variables (above) were used to describe baseline employment status. The multinomial model or generalized logit estimated two binary logits simultaneously, in

particular the 'full-time vs. not employed' model and the 'part-time/casual vs. not employed' model. Each model's regression equation resembled the following:

$$\log(odds) = \text{int}ercept + \beta_1 gender(Male) + ... + \text{int}eractions$$

The main effects and interactions parameter estimates, standard errors and p-values for the 'full-time vs. not employed' model are presented (*Table 53* and *54*, respectively).

Table 53. Main effects parameter estimates for 'full-time vs. not employed' model

Variable	Variable category	Parameter Estimate	Standard Error	p
Intercept	-	-1.4593	0.3618	<0.0001
Gender	Female (ref.)			
	Male	1.0177	0.4678	0.0296
Age (years)	30-39 (ref.)			
	Under 30	-1.5765	0.3595	<0.0001
	40-49	0.3427	0.1709	0.0450
	50 and over	0.0969	0.2208	0.6608
Region of origin	North America, Western Europe (ref.)			
	Africa	-0.2839	0.3835	0.4592
	Caribbean, C/S America	0.1268	0.3892	0.7445
	East Asia	0.8338	0.3763	0.0267
	Eastern Europe	0.6052	0.3644	0.0967
	South Asia	-0.4966	0.3417	0.1461
	Southeast Asia	0.7435	0.396	0.0605
	West Asia	-0.9028	0.3804	0.0176
Citizenship status	Canadian Citizen (ref.)			
	Permanent Resident	-0.8677	0.1751	<0.0001
	Temporary Resident	0.0285	0.2823	0.9195
	Other/ not answered	1.5836	0.2971	<0.0001
First language spoken (is official language)	No (ref.)			
	Yes	0.2490	0.1145	0.0297
	Not answered	-0.00091	0.1300	0.9944
Time from entry	Less than 1 Year (ref.)			
	1-5 Years	0.8473	0.1013	<0.0001
	5-10 Years	1.0731	0.1605	<0.0001
	Over 10 Years	1.2770	0.1925	<0.0001

The p-values highlighted which variable categories (vs. reference category) were

significant and which were not at the 0.05 level. For instance, IMGs who were men had a parameter estimate (coefficient) of 1.0177, a standard error of 0.4678, and a significant p-value of 0.0296, while women had a value of 0 for the coefficient (as they were the reference level). In order to obtain the overall effect from that equation for a particular individual, a number of variables have to be specified; the 1.0177 coefficient is only one part of the overall equation that determines the odds of full-time employment (versus not full-time employment).

Table 54. Interactions parameter estimates for 'full-time vs. not employed' model

Interaction	First variable category	Interacting variable category	Param. Est.	Std. Error	p
Interaction of age (years) and citizenship status	30-39 (ref.)	Canadian citizen (ref.)			
	Under 30	Permanent resident	1.3767	0.3978	0.0005
		Temporary resident	1.0029	0.5385	0.0626
		Other/not answered	0.8078	0.5841	0.1667
	40-49	Permanent resident	-0.2661	0.2105	0.206
		Temporary resident	-0.7978	0.4897	0.1033
		Other/not answered	-0.3289	0.5581	0.5556
	50 and over	Permanent resident	-0.3626	0.2939	0.2173
		Temporary resident	-11.8214	174.800	0.9461
		Other/not answered	-3.1099	1.16530	0.0076
Interaction of gender and region of origin	Female (ref.)	North America, Western Europe (ref.)			
	Male	Africa	0.0220	0.5281	0.9667
		Caribbean, C/S America	-0.1106	0.5504	0.8407
		East Asia	-0.8733	0.5387	0.1050
		Eastern Europe	-0.723	0.5359	0.1772
		South Asia	0.0776	0.4895	0.8740
		Southeast Asia	-1.0417	0.5804	0.0727
		West Asia	-0.0159	0.5208	0.9756

The main effects and interactions parameter estimates, standard errors and p-values for the 'part-time/casual vs. not employed' model are presented (*Table 55* and *56*, respectively).

Table 55. Main effects parameter estimates for 'part-time/casual vs. not employed' model

Variable	Variable category	Parameter Estimate	Standard Error	p
Intercept	-	-1.7988	0.4099	<0.0001
Gender	Female (ref.)			
	Male	0.6086	0.5480	0.2668
Age (years)	Under 30	-0.8588	0.3253	0.0083
	30-39 (ref.)			
	40-49	0.146	0.1892	0.4403
	50 and over	-0.061	0.2467	0.8046
Region of origin	North America, Western Europe (ref.)			
	Africa	-0.3499	0.4275	0.4130
	Caribbean, C/S America	0.2705	0.4319	0.5311
	East Asia	0.1315	0.4368	0.7633
	Eastern Europe	0.0476	0.4174	0.9092
	South Asia	-0.5844	0.3866	0.1306
	Southeast Asia	0.3237	0.4607	0.4823
	West Asia	-0.4659	0.4083	0.2539
Citizenship status	Canadian Citizen (ref.)			
	Permanent Resident	-0.6118	0.1875	0.0011
	Temporary Resident	-0.761	0.4201	0.0701
	Other/ not answered	-0.1861	0.4680	0.6908
First language spoken (is official language)	No (ref.)			
	Yes	-0.1894	0.1534	0.2169
	Not answered	0.3002	0.1249	0.0162
Time from entry	Less than 1 Year (ref.)			
	1-5 Years	1.2516	0.1164	<0.0001
	5-10 Years	1.4573	0.1779	<0.0001
	Over 10 Years	1.5303	0.2168	<0.0001

The interaction of *age* and *citizenship status* had the following parameter estimates (model coefficients) (*Table 56*). Depending on the characteristics of a particular IMG, different coefficient values are entered into the equation to find the overall effect (regarding the odds of full-time vs. not employed in this case).

Table 56. Interactions parameter estimates for 'part-time/casual vs. not employed' model

Variable	Variable category	Interacting variable category	Param. Est.	Standard Error	p
Interaction of age (years) and citizenship status	30-39 (ref.)	Canadian citizen (ref.)			
	Under 30	Permanent resident	0.9953	0.3636	0.0062
		Temporary resident	0.6682	0.6900	0.3328
		Other/not answered	0.4065	0.9333	0.6632
	40-49	Permanent resident	-0.3286	0.2364	0.1645
		Temporary resident	-0.8117	0.8548	0.3423
		Other/not answered	0.8746	0.7669	0.2541
	50 and over	Permanent resident	-0.0679	0.3197	0.8319
		Temporary resident	1.0026	0.9294	0.2807
		Other/not answered	-0.6432	1.2315	0.6015
Interaction of gender and region of origin	Female (ref.)	North America, Western Europe (ref.)			
	Male	Africa	-0.0242	0.6097	0.9684
		Caribbean, C/S America	-0.3738	0.6377	0.5578
		East Asia	-1.1012	0.6612	0.0958
		Eastern Europe	-0.1339	0.6224	0.8297
		South Asia	0.2693	0.5693	0.6361
		Southeast Asia	-0.8609	0.7004	0.2190
		West Asia	-0.3819	0.5892	0.5169

For the non-interacting terms, the odds ratios are presented (*Table 57* and *58*). *Table 57* shows the odds ratios for the non-interacting terms for the 'full-time vs. not employed' model, while *Table 58* also shows odds ratios (ORs), for the 'part-time vs. not employed' model.

Table 57. Odds ratios for non-interacting terms for the 'full-time vs. not employed' model (N=4560)

Variable	**Odds ratio [95% confidence interval]**	**Interpretation** (odds of full-time status)
Time from entry		
Less than 1 year	Reference	
1-5 years	2.333 [1.913, 2.846]	Over 2x the odds
5-10 years	2.924 [2.135, 4.005]	Almost 3x the odds
Over 10 years	3.586 [2.459, 5.229]	About 3½x the odds
First language spoken (is official language)		
No	Reference	
Yes	0.999 [0.774, 1.289]	No difference
Not answered	1.283 [1.025, 1.606]	Over 1x the odds

For *time from entry*, both *Tables 57 & 58* show increasing ORs as *time from entry* increases, however the ORs are higher for the second comparison (part-time vs. not employed) in relation to the first (full-time vs. not employed). For the *first language spoken (is official language)* variable, there was no difference between those who spoke one of Canada's official languages first or not, with regards to working in a full-time or a part-time job over not being employed. For those who did not answer, they may have had slightly greater odds of full-time or part-time employment, but it is not known why this group chose not to answer this question on the Access Centre's online registration form.

Table 58. Odds ratios for non-interacting terms for the 'part-time vs. not employed' model (N=4560)

Variable	**Odds ratio [95% confidence interval]**	**Interpretation** (odds of part-time/casual status)
Time from entry		
Less than 1 year	Reference	
1-5 years	3.496 [2.783, 4.391]	About 3½x the odds
5-10 years	4.295 [3.030, 6.086]	Over 4x the odds
Over 10 years	4.619 [3.020, 7.065]	Over 4½x the odds
First language spoken (is official language)		
No	Reference	
Yes	0.827 [0.613, 1.118]	No difference
Not answered	1.350 [1.057, 1.725]	Over 1x the odds

By looking at the results for *time from entry* for the 'full-time vs. not employed' model in a visual way (*Figure 25*), it can be seen that compared to the reference group, IMGs who had been in Canada longer had greater odds of full-time employment, but the 95% confidence intervals for all the categories overlap. This means that this variable could have been dichotomized into 'less than 1 year' and 'more than 1 year' in Canada, where IMGs who have been in Canada more than 1 year had at least twice the odds of full-time employment. By looking at the results for *first language spoken (is official language)*, there is no statistical difference between IMGs who first spoke English or French and those who did not regarding the odds of full-time employment (*Figure 26*), but those who did not answer did have almost 30% greater odds, but the 95% confidence interval overlaps with the 'yes' category' 95% confidence interval.

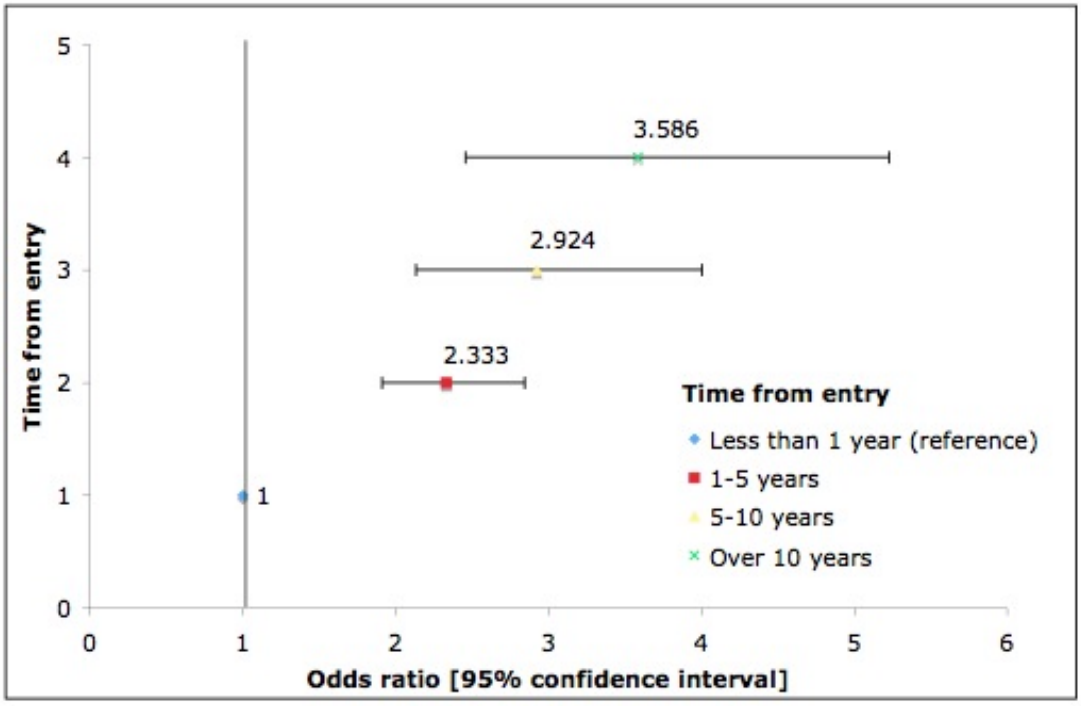

Figure 25. Odds ratios [95% confidence intervals] for time from entry ('full-time vs. not employed' model)

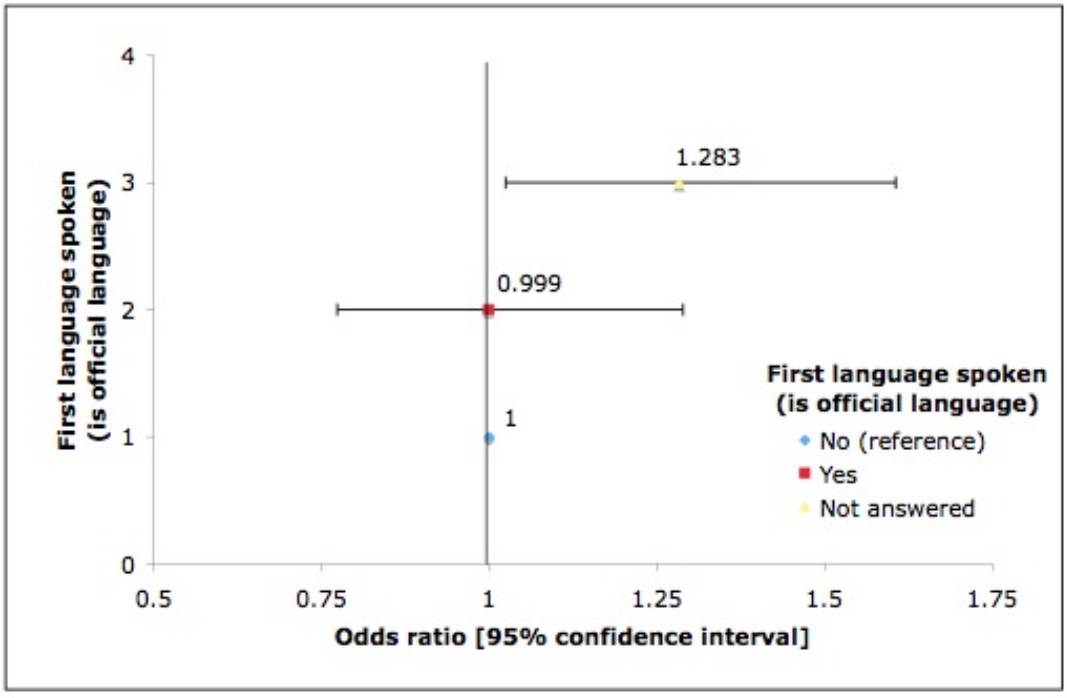

Figure 26. Odds ratios [95% confidence intervals] for first language spoken (is official language) ('full-time vs. not employed' model)

The results for *time from entry* for the 'part-time/casual vs. not employed' model can be seen in a visual way (*Figure 27*). Compared to the reference group, IMGs who had been in Canada longer had greater odds of full-time employment, but the 95% confidence intervals for all the categories overlap. This means that this variable could have been dichotomized into 'less than 1 year' and 'more than 1 year' in Canada, where IMGs who have been in Canada more than 1 year had at least three times the odds of full-time employment.

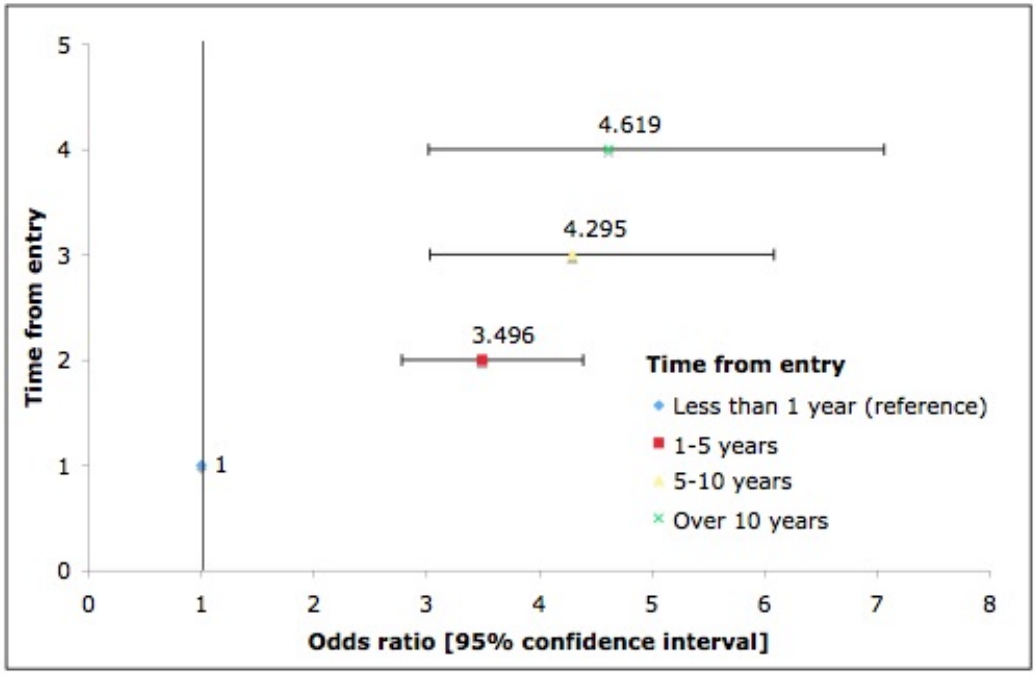

Figure 27. Odds ratios [95% confidence intervals] for time from entry ('part-time/casual vs. not employed' model)

By looking at the results for *first language spoken (is official language)*, there is no statistical difference between IMGs who first spoke English or French and those who did not regarding the odds of full-time employment (*Figure 28*), but those who did not answer did have almost 35% greater odds, but the 95% confidence interval overlaps with the 'yes' category' 95% confidence interval. Therefore, first language speakers of English or French did not have greater (or lesser) chances of finding part time or casual employment (vs. no employment) since the 95% confidence interval contained '1' for the Odds Ratio.

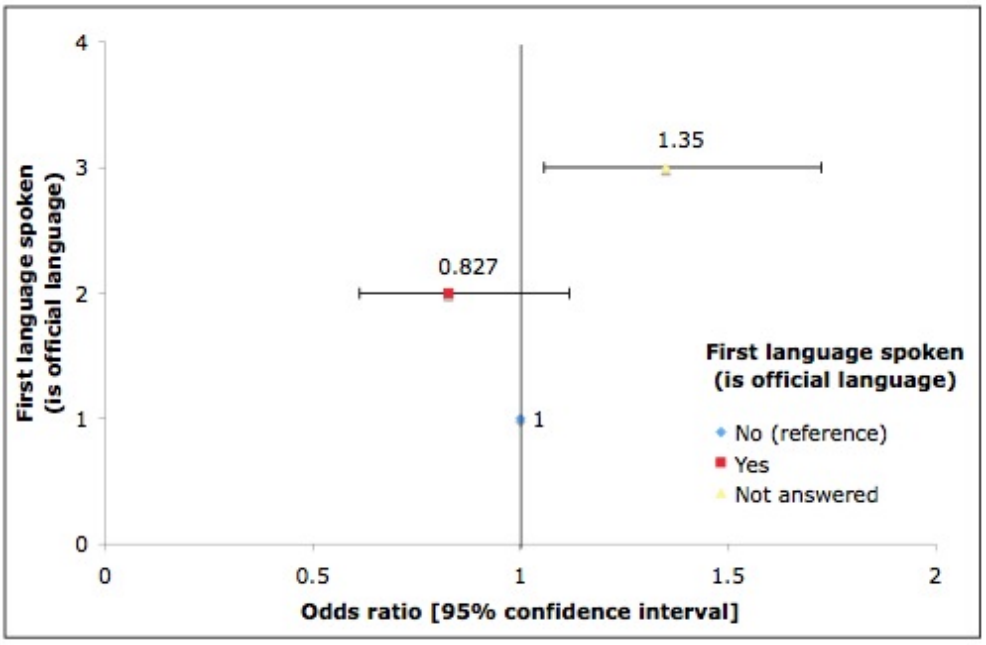

Figure 28. Odds ratios [95% confidence intervals] for first language spoken (is official language) ('part-time/casual vs. not employed' model)

The interactions that were significant included: *gender* and *region of origin;* and *citizenship status* and *age*. The interaction odds ratios for each model are presented (*Tables 39* and *40*). For *age*, since it was interacting with *citizenship status*, it was best to present odds ratios for each *age* category vs. the reference category (30-39 years old) at each *citizenship status* category (Canadian citizen, permanent resident, temporary resident, or other/not answered), respectively.

The effect of *age* on 'full-time vs. not employed' was slightly altered by *citizenship status* (*Table 59*). This was apparent in the magnitude of the odds ratios across *age* group comparisons. However, the general trend (in the raw odds ratios) still exists, namely that, those Under 30 have lower odds of full-time employment, while those 40-49 years have slightly higher chances, and then that decreases again for those 50-59 years, all compared to reference group (30-39 years). Taking into account the 95% confidence intervals, some of the trends are not apparent, as there was no statistical difference between the *age* groups (and the reference group).

Table 59. Interaction odds ratios for 'full-time vs. not employed' model (N=4560)

Variable		**Odds ratio [95% confidence interval]**	**Interpretation** (odds of full-time status)
Age (years)	**At citizenship status**		
30-39		Reference	
Under 30	Canadian	0.207 [0.102, 0.418]	About $^{1}/_{5}$x the odds
40-49	citizen	1.409 [1.008, 1.969]	Almost 1½x the odds
50 and over		1.101 [0.715, 1.698]	No difference
Under 30	Permanent	0.819 [0.587, 1.143]	No difference
40-49	resident	1.080 [0.846, 1.378]	No difference
50 and over		0.767 [0.523, 1.124]	No difference
Under 30	Temporary	0.564 [0.257, 1.236]	No difference
40-49	resident	0.634 [0.258, 1.560]	No difference
50 and over*		0.001 [<0.001, >999]	No difference
Under 30	Other/not	0.464 [0.188, 1.144]	No difference
40-49	answered	1.014 [0.358, 2.871]	No difference
50 and over		0.049 [0.005, 0.463]	Less than $^{1}/_{100}$x the odds
Region of origin	**At gender**		
North America, Western Europe		Reference	
Africa	Men	0.770 [0.370, 1.602]	No difference
Caribbean, C/S America		1.016 [0.466, 2.216]	No difference
East Asia		0.961 [0.436, 2.119]	No difference
Eastern Europe		0.889 [0.399, 1.980]	No difference
South Asia		0.658 [0.324, 1.337]	No difference
Southeast Asia		0.742 [0.315, 1.746]	No difference
West Asia		0.399 [0.193, 0.826]	Almost ½x the odds
Africa	Women	0.753 [0.355, 1.596]	No difference
Caribbean, C/S America		1.135 [0.529, 2.434]	No difference
East Asia		2.302 [1.101, 4.813]	Over 2x the odds
Eastern Europe		1.832 [0.897, 3.741]	No difference
South Asia		0.609 [0.312, 1.189]	No difference
Southeast Asia		2.103 [0.968, 4.571]	No difference
West Asia		0.405 [0.192, 0.855]	No difference

*Note: ORs for this category have a very imprecise 95% CI probably due to the small number of IMGs who were 50 and over and temporary residents.

Table 60. Interaction odds ratios for 'part-time/casual vs. not employed' (N=4560)

Variable		Odds ratio [95% confidence interval]	Interpretation (odds of part-time/casual status)
Age (years)	**At citizenship status**		
30-39		Reference	
Under 30	Canadian	0.424 [0.224, 0.802]	About $^{2}/_{5}$x the odds
40-49	citizen	1.157 [0.799, 1.677]	No difference
50 and over		0.941 [0.580, 1.527]	No difference
Under 30	Permanent	1.146 [0.834, 1.576]	No difference
40-49	resident	0.833 [0.629, 1.104]	No difference
50 and over		0.879 [0.589, 1.312]	No difference
Under 30	Temporary	0.826 [0.251, 2.724]	No difference
40-49	resident	0.514 [0.100, 2.633]	No difference
50 and over		2.564 [0.443, 14.925]	No difference
Under 30	Other/not	0.636 [0.114, 3.538]	No difference
40-49	answered	2.775 [0.647, 11.907]	No difference
50 and over		0.495 [0.046, 5.263]	No difference
Region of origin	**At Gender**		
North America, Western Europe		Reference	
Africa	Men	0.688 [0.286, 1.656]	No difference
Caribbean, C/S America		0.902 [0.352, 2.312]	No difference
East Asia		0.379 [0.138, 1.043]	No difference
Eastern Europe		0.917 [0.358, 2.353]	No difference
South Asia		0.730 [0.313, 1.703]	No difference
Southeast Asia		0.584 [0.202, 1.689]	No difference
West Asia		0.428 [0.179, 1.023]	No difference
Africa	Women	0.705 [0.305, 1.629]	No difference
Caribbean, C/S America		1.311 [0.562, 3.056]	No difference
East Asia		1.141 [0.235, 2.685]	No difference
Eastern Europe		1.049 [0.463, 2.377]	No difference
South Asia		0.557 [0.261, 1.189]	No difference
Southeast Asia		1.382 [0.560, 3.410]	No difference
West Asia		0.628 [0.282, 1.397]	No difference

For *region of origin,* there was also effect modification (*Table 59*). All of the odds ratios are not significant, except one for two. Male IMGs from West Asia have lower odds of full-time employment than male IMGs from North America or Western Europe. In contrast, female IMGs from East Asia have twice the odds of full-time employment than those from

the reference group.

Only a single odds ratio was significant for the interaction terms of the 'part-time/casual vs. no employment' model (*Table 60*). IMGs who were under 30 years old and Canadian citizens had only two-fifths the odds of part-time/casual vs. no employment compared to IMGs who were 30-39 years old and were Canadian citizens. Since none of the interaction odds ratios for *region of origin* and *gender* were significant, that interaction was not part of the 'part-time/casual vs. no employment' model. Only the single interaction of *age* and *citizenship status* was included.

5.5. Professional integration outcome

5.5.1. Description of the survival data

Professional integration was defined as securing a residency position in Canada or the United States[44]. IMG users of the Access Centre who have not yet secured positions at the study end date (April 14, 2011) were termed, 'right censored'.

Excluded from this analysis were: IMGs who had secured residencies abroad, IMGs whose residency start dates could not be elucidated from information provided, IMGs who registered at the Access Centre after starting residency, IMGs who did not specify their age or gender or IMGs who were not living in Ontario, Canada as well as IMGs who registered with the Access Centre before Jan. 1, 2007 (*Figures 29 & 30*).

The variable that described how long (in months) an IMG has been in contact with the Access Centre from the point of registration till starting a residency position or the study end date was the 'time from registration until integration outcome' variable. 246 out of 294 IMGs (84%) provided their date of completion (or expected completion) of residency, which allowed for the elucidation of their residency start dates, along with other relevant information provided such as the school, program and country of post-graduate education information to create a program length variable and to subtract that from the date of completion of residency. 48 out of 294 IMGs (16%) did not provide the date of completion of residency, and their residency start dates were estimated through a combination of the last

[44] Only a handful of IMGs who had secured residencies in Canada or the US were able to complete them during the study period and already be registered with the College of Physicians and Surgeons of Ontario and be practicing in the province.

time they applied to the Canadian Resident Matching Service (CaRMS) or Electronic Residency Application Service (ERAS) and/or the last time they received a residency interview, and any other information provided.

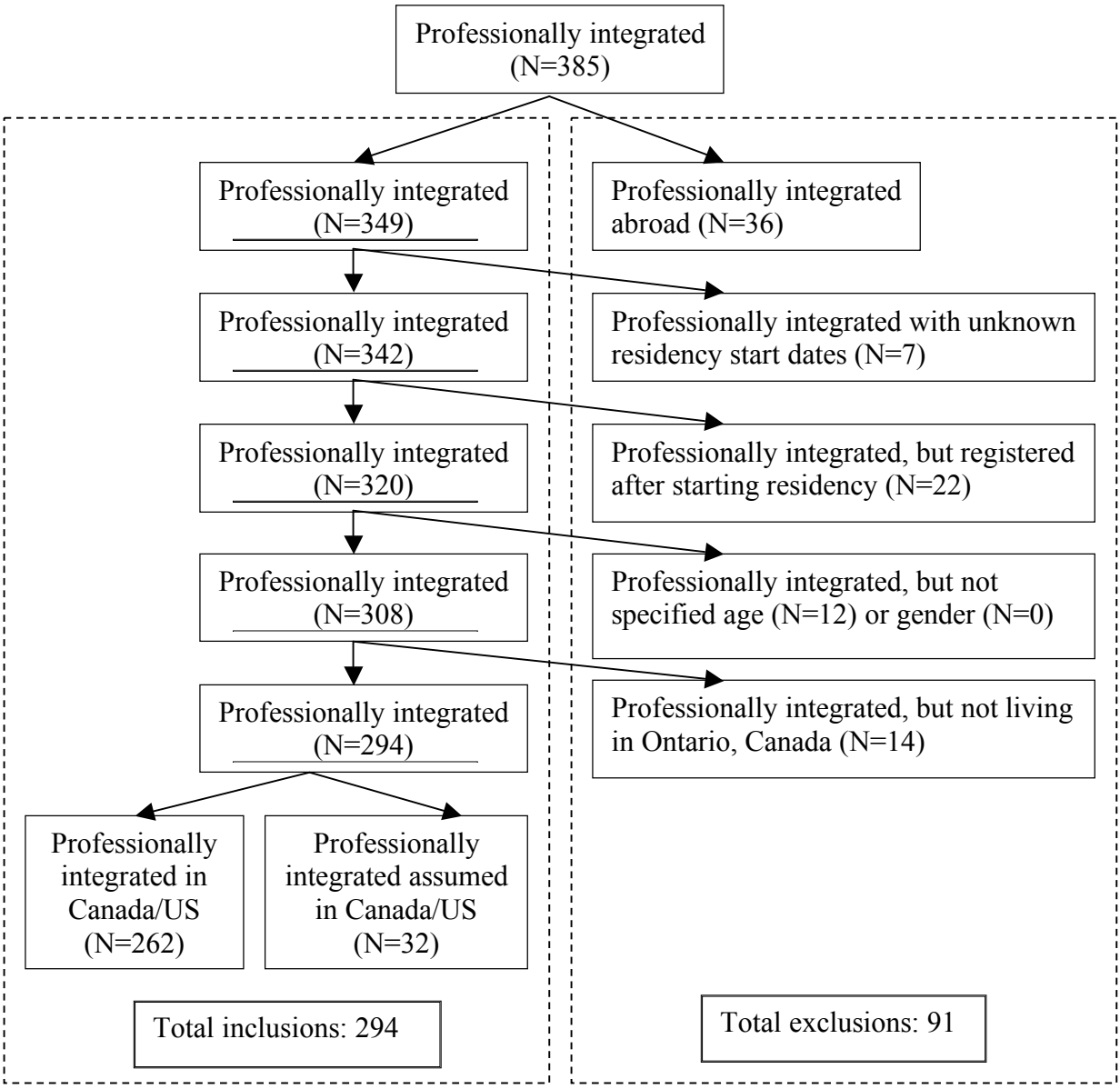

Figure 29. Professionally integrated inclusion/ exclusion flow chart

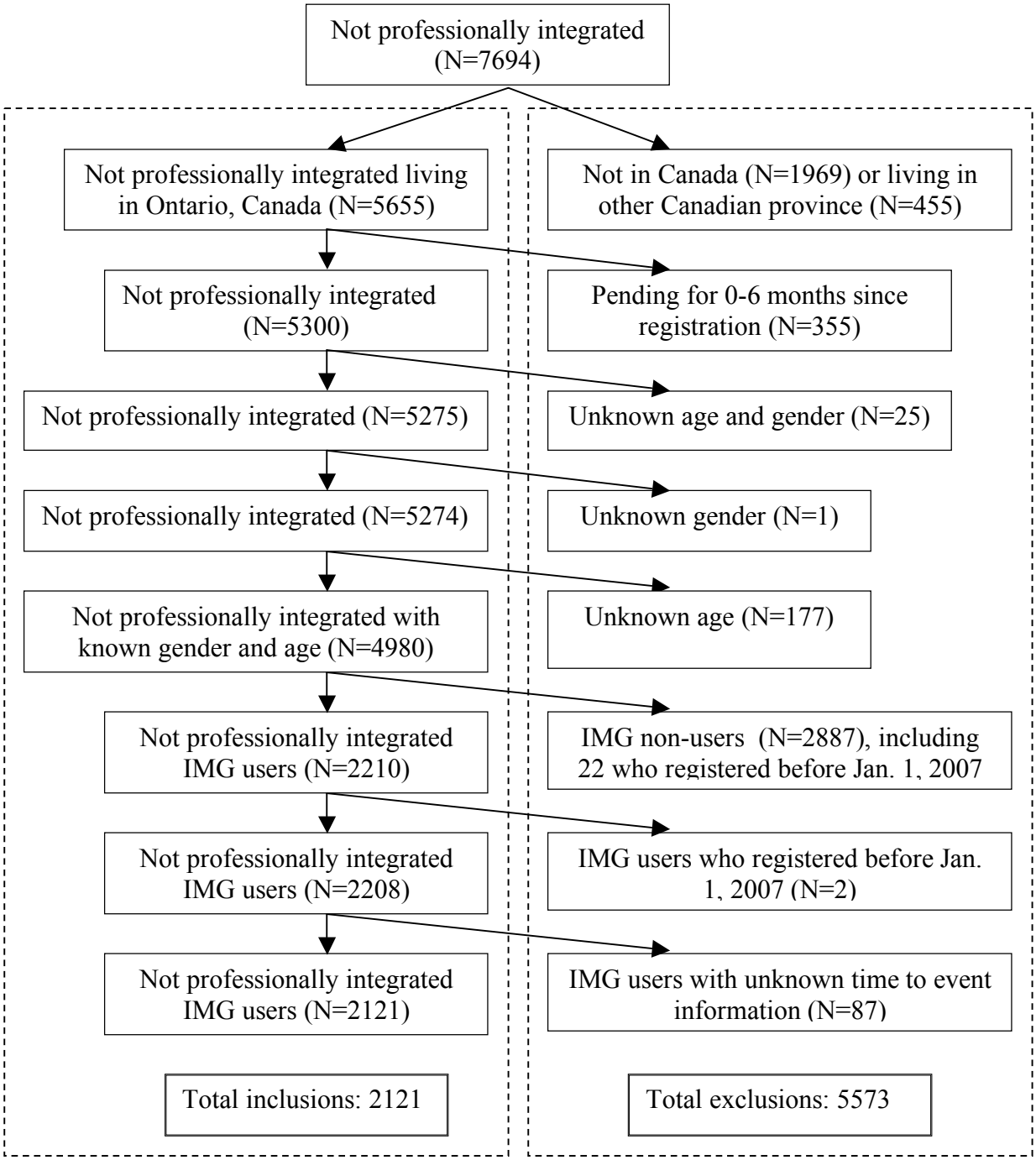

Figure 30. Not professionally integrated inclusion/ exclusion flow chart

Those IMGs who did not obtain a residency position during the study period were right censored at the study end date (April 14, 2011). Since their registration dates were known (100%), then their times from registration until integration outcome were simply calculated.

In the survival analysis, it was important to specify the method used to account for ties in the event times. If ties handling was left unspecified, *Breslow's approximation* could have been used, but it is poor when there were many ties. A table shows the survival times by professional integration outcome were highly tied (*Table 61*). For instance, at survival time = 0, 24 IMGs were professionally integrated, while 20 IMGs were not professionally integrated. This meant that within one month of registration at the Access Centre, 24 IMGs were able to secure a residency position in Canada or the US[45], while 20 others were not. Since the times from registration until integration outcome (survival times) were highly tied, a different method from Breslow's approximation needed to be used. Therefore, the most appropriate method to use here was the *discrete method*, which assumes the events really occurred exactly the same time (within the same month), and there is no specific ordering of events within that month[46]..

It is important to note that the typical CaRMS application process for an IMG takes 7 months from beginning of August when registration opens till the first Tuesday of March (match day), while residency usually starts beginning of July. Over the course of the 7 months, IMGs have to submit documents such as letters of reference or performance reports. The survivor function was defined as $S(t) = Pr\{T>t\} = 1 - F(t)$, which gives the probability of surviving beyond time, t. In this case, this means the probability of not securing a residency position in Canada or the US beyond time, t. The Kaplan-Meier (KM) method (also known as the product-limit estimator) estimates survivor functions. Also in this case there was only single right censoring, wherein censored cases were all censored at the same time, c (April 14, 2011) and all observed event times were less than c.

[45] Only IMGs living in Ontario, Canada at the time of registration were included. This meant that if an IMG secured a position in the US, they would be migrating to the US for the duration of the training and could either return to Canada or practice elsewhere. Some IMGs who obtained residencies in the US may have had US citizenship as well (but they were included because they met the inclusion criteria).

[46] This is the recommendation provided in a standard textbook of survival analysis by Paul D. Alliston, *Survival Analysis Using the SAS System* published in 2010.

Table 61. Survival times by professional integration outcome

Survival time (months)	Professional Integration		Survival time (months)	Professional Integration	
	No	Yes		No	Yes
0	24	20	28	32	3
1	29	12	29	32	3
2	43	20	30	39	4
3	35	9	31	28	6
4	53	7	32	38	6
5	60	14	33	30	4
6	60	14	34	22	5
7	99	11	35	30	3
8	136	6	36	20	5
9	136	4	37	32	4
10	113	8	38	34	1
11	108	18	39	14	1
12	68	6	40	27	1
13	51	7	41	30	0
14	59	6	42	11	1
15	47	5	43	13	3
16	37	8	44	8	2
17	60	8	45	11	0
18	47	5	46	15	2
19	58	10	47	20	1
20	53	8	48	8	0
21	52	6	49	7	1
22	41	7	50	3	0
23	25	3	51	1	1
24	50	4	54	0	1
25	22	4	66	0	1
26	28	3	72	0	1
27	22	1	Total	2121	294

Estimating the survivor function using the KM method allows for the determination of the mean and median survival times. The median was 51 months with 95% confidence interval of 51 to 60 months after registration. The mean was 45.5 months with a standard error of 1.4 months. The total number of IMGs was 2415, where 294 became professionally integrated (12.2%) and 2121 did not obtain residencies (87.8%). Plots of the estimated survivor function, with 95% pointwise confidence limits (CL), showing those censored (+) (*Figure 31*) and with the number of subjects at risk with 95% CL and Hall-Wellner equal precision bands (*Figure 32*) are shown.

It was thought that possibly those IMGs who found out about the Access Centre early in the study time period could have experienced a longer delay before entering a residency program. However, survival analysis takes this into account – no matter how long an individual happens to be at the Access Centre, by looking at the survival curve at a particular time (for example, at around 30 months), it appears there is an 80% survival probability. This translates into a 20% probability of integration –but this is for those IMGs who have been at the centre for at least 30 months. Many IMGs have been at the Access Centre a much shorter time so they are censored (+) after the time they did spend in contact with the centre. This also explains why the survival curve (*Figure 31*) reaches 0% survival probability (since everyone in the study has either been censored (+) or has become integrated.

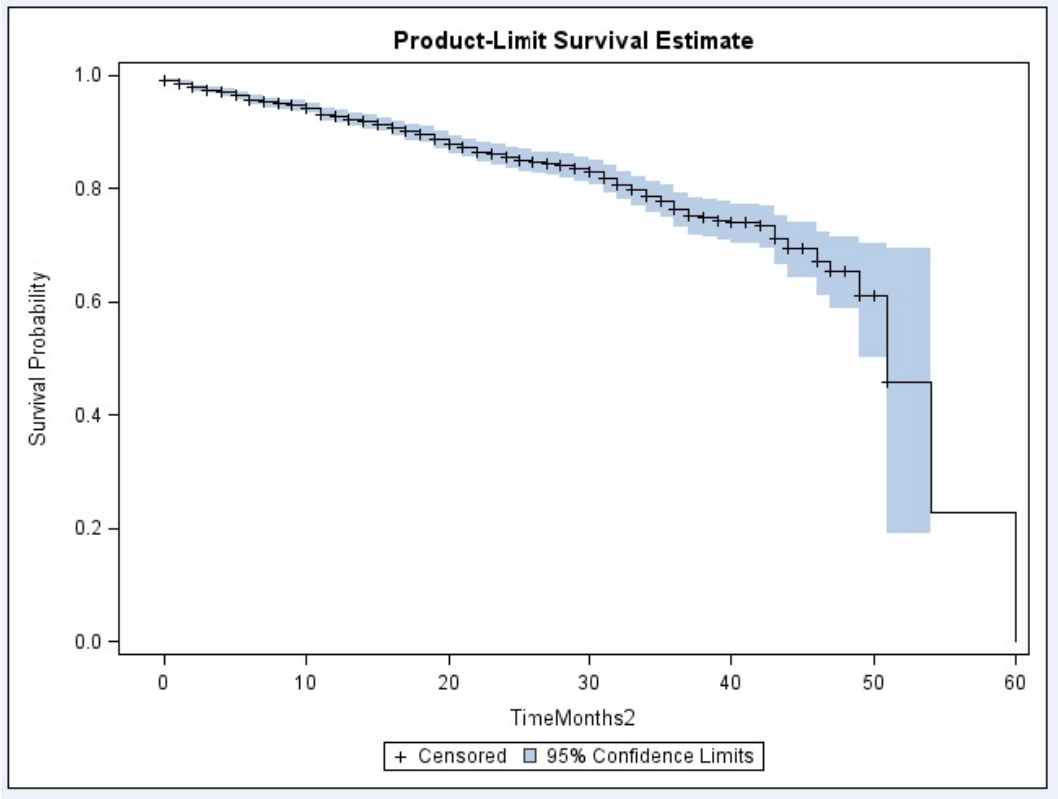

Figure 31. Plot of the estimated survivor function using the KM method

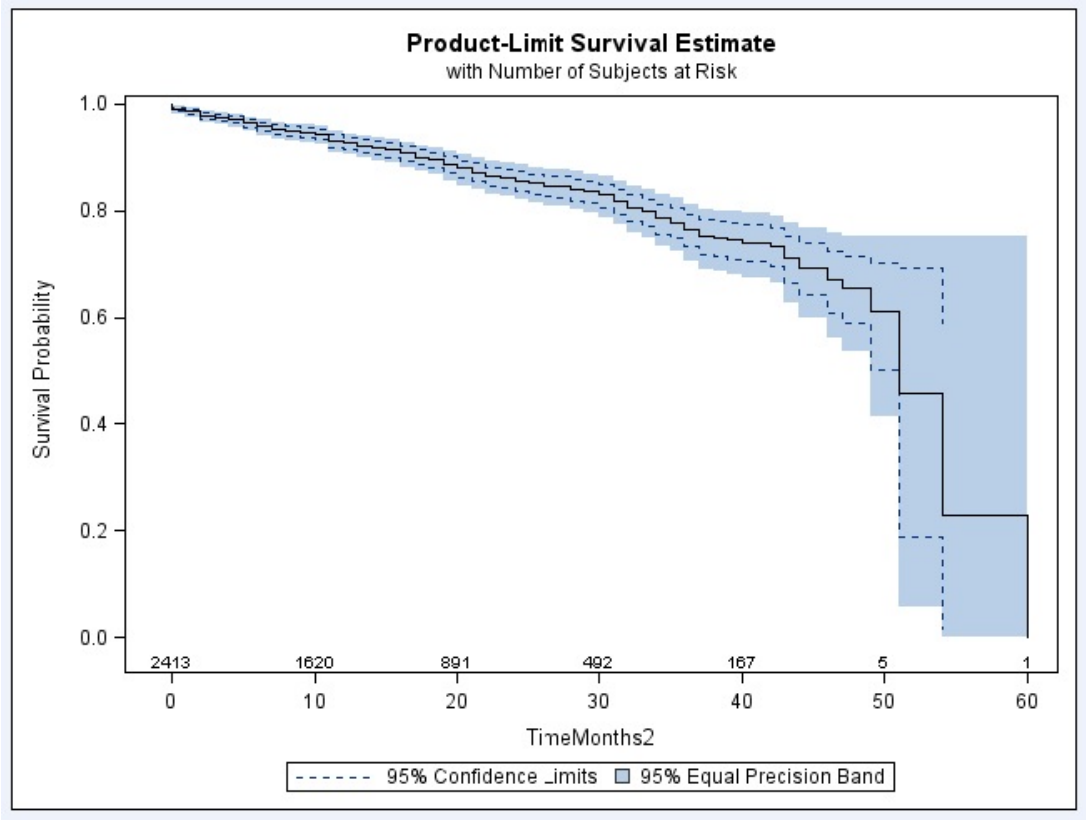

Figure 32. Plot of the estimated survivor function with number of subjects at risk

5.5.2. Model development

The variables of interest were determined to be those that had been previously used in literature and/or had the least missing data, after exclusions:

Demographic variables	Educational/training variables	Socioeconomic variables
▪ Gender ▪ Age ▪ City type/ urban status ▪ Citizenship status ▪ Region of origin ▪ Time from entry ▪ First language spoken (is official language)	▪ Region of education ▪ Time from graduation to registration ▪ Took MCCEE ▪ Took MCCQE1 ▪ Took CE1	▪ Baseline employment status ▪ Full-time employment status ▪ Number of people in household ▪ Household income

Note: Registration date (used to derive time from graduation/entry variables)

It was important to verify the amount of missing data for each variable by IMGs who became

and who did not become professionally integrated (*Table 62*). All IMGs with unknown *gender* and *age* were excluded, so complete information is available for those variables. *Took MCCEE/MCCQE1/CE1* variables were 100% complete. The difference between the percent missing for those integrated and not integrated was small (less than 5%) for: *citizenship status, region of origin, time from entry,* and *region of education.* The difference was large (over 5%) for the following variables: *first language spoken (is official language), baseline employment status, baseline full-time status, number of people in household,* and *household income*. It was interesting that for the variables that had a large difference in the % missing values by professional integration outcome, there were much more missing values for those that become integrated versus those who did not. Since this could skew the results, the variables that had greater than 5% difference in missing values between professional integration outcomes were excluded from further analyses.

Table 62. Percent missing of each variable by professional integration outcome

Variable	**Integrated**		**Not integrated**		**% Difference**
	n	**%**	**n**	**%**	**-**
Total	294	100	2121	100	-
Gender	0	0	0	0	0
Age	0	0	0	0	0
City type	0	0	0	0	0
Urban status	0	0	0	0	0
Citizenship status	5	2	20	1	1
Region of origin	12	4	4	0	4
Time from entry	11	4	23	1	3
First language spoken (is official language)	84	29	150	7	22
Region of education	0	0	2	0	0
Time from graduation to registration	48	16	140	7	9
Took MCCEE	0	0	0	0	0
Took MCCQE1	0	0	0	0	0
Took CE1	0	0	0	0	0
Baseline employment status	87	30	24	1	29
Baseline full-time status	87	30	24	1	29
Number of people in household	89	30	68	3	27
Household income	130	44	117	5	39

Univariate analysis of professional integration outcome by each variable level was performed (*Table 63*). Characteristics of IMGs who became professionally integrated and

those who did not were described. 63% of those who became professionally integrated were women compared to 37% men, while of those who did not, only 52% were women, while 48% were men.

Table 63. Characteristics of IMGs by professional integration outcome (N=2415)

Characteristic	Total		Professional integration				p
			Yes		No		
	n	%	n	%	n	%	
	2415	100.0	294	100.0	2121	100.0	
Gender							<0.0001
Female	1294	53.6	186	63.3	1108	52.2	
Male	1121	46.4	108	36.7	1013	47.8	
Age							<0.0001
Under 30	466	19.3	90	30.6	376	17.7	
30-39	1013	42.0	152	51.7	861	40.6	
40-49	713	29.5	49	16.7	664	31.3	
50 and over	223	9.2	3	1.0	220	10.4	
City type							0.8106
Town	16	0.7	2	0.7	14	0.7	
Small City	38	1.6	6	2.0	32	1.5	
Medium City	44	1.8	4	1.4	40	1.9	
Large City	2314	95.9	282	95.9	2032	95.8	
Urban status							1.0000
No	98	4.1	12	4.1	86	4.0	
Yes	2314	95.9	282	95.9	2032	95.8	
Region of origin							<0.0001
Africa	306	12.7	28	9.5	278	13.1	
Caribbean, C/S America	155	6.4	22	7.5	133	6.3	
East Asia	129	5.3	10	3.4	119	5.6	
Eastern Europe	187	7.7	25	8.5	162	7.6	
North America, Western Europe	68	2.8	18	6.1	50	2.3	
South Asia	925	38.3	112	38.1	813	38.3	
Southeast Asia	105	4.3	8	2.7	97	4.6	
West Asia	524	21.7	59	20.1	465	21.9	
Not answered	16	0.7	12	4.1	4	0.2	
Citizenship status							<0.0001
Canadian Citizen	542	22.4	112	38.1	430	20.3	
Permanent Resident	1691	70.0	170	57.8	1521	71.7	
Temporary Resident	100	4.14	5	1.7	95	4.5	
Other/ not answered	82	3.4	7	2.4	75	3.5	

Characteristic	Total		Professional integration Yes		No		p
	n	%	n	%	n	%	
	2415	100.0	294	100.0	2121	100.0	
Time from entry							<0.0001
Less than 1 Year	1227	50.8	63	21.4	1164	54.9	
1-5 Years	682	28.2	135	45.9	547	25.8	
5-10Years	361	12.5	61	20.7	240	11.3	
Over 10 Years	171	7.1	24	8.2	147	6.9	
Not answered	34	1.4	11	3.7	23	1.1	
Region of education							<0.0001
Africa	294	12.2	27	9.2	267	12.6	
Caribbean, C/S America	187	7.7	28	9.5	159	7.5	
East Asia	128	5.3	10	3.4	118	5.6	
Eastern Europe	299	12.4	39	13.3	260	12.2	
North America, Western Europe	70	2.9	23	7.8	47	2.2	
South Asia	842	34.9	100	34.0	742	35.0	
Southeast Asia	103	4.3	6	2.0	97	4.6	
West Asia	490	20.3	61	20.7	429	20.2	
Not answered	2	0.1	0	0	2	0.1	
Took MCCEE							<0.0001
No	1262	52.3	18	6.1	1244	58.7	
Yes	1153	47.7	276	93.9	877	41.3	
Took MCCQE1							<0.0001
No	1638	67.8	67	22.8	1571	74.1	
Yes	777	32.2	227	77.2	550	25.9	
Took CE1							<0.0001
No	1987	82.3	145	49.3	1842	86.8	
Yes	428	17.7	149	50.7	279	13.2	

The majority of IMGs who became integrated were either under 30 years old (31%) or 30-39 years old (52%); while the majority of IMGs who did not become professionally integrated were either 30-39 years old (41%) or 40-49 years old (31%). Not much can be said about the *city type* or *urban status* variables beyond the fact that most IMGs lived in large urban localities. The distribution of IMGs by *region of origin* was similar for IMGs who became or did not become integrated. Although there were some differences such as three times as many (percentage wise) IMGs from North America, Western Europe who became integrated compared to those from that region who did not, for instance. Of those who became integrated, 58% were permanent residents, and 38% were Canadian citizens. Of

those who did not, more than 70% were permanent residents, while only 20% were Canadian citizens. The distribution of IMGs by *time from entry* was quite diverse. For those who became integrated, the greatest number have been in Canada 1-5 years, while for those who did not, the greatest number were in Canada less than 1 year.

For the variable, *region of education*, there were very similar percentages of IMGs who completed their medical degrees and became integrated compared to those who did not (*Table 63*). About 94% of IMGs who became integrated took the MCCEE exam, while 59% of IMGs who did not become integrated did not take the MCCEE exam. Since the MCCEE is a requirement to apply to residency in Canada, of those 6% that obtained residency positions, some of them may have obtained them in the United States, while others may have made a mistake while completing the online registration form, most likely. Of those who became integrated, 77% took to the MCCQE1 exam, while of those who did not, 74% did not take it. Although the MCCQE1 is recommended, it is not a requirement to apply to many jurisdictions in Canada (it is completed while in residency), while some do require it. 50% of those IMGs who became integrated took the CE1 exam, while 87% of IMGs who did not become integrated did not take the CE1 exam.

Log-rank tests showed whether there was a difference between levels of each variable and the dichotomous professional integration outcome. *City type* (p=0.8106) and *urban status* (p=1.000) were not included in the survival analysis due to not significant p-values. Those 2 IMGs with unanswered *region of education* were excluded to avoid low cell counts. Within the variables: *time from entry* and *region of origin*, a category for those who did not answer was included. This was because those factors were not part of the exclusion criteria and something could still be said about those who chose not to answer those questions. For those who did not answer the citizenship status question, the 'not answered' category had been combined with the 'other' category, to avoid low cell counts.

Stepwise selection using SAS software for these covariates with an entry p-value of 0.25 and a stay p-value of 0.05, and testing for all two-way interactions yielded the following covariates entered and retained (*Table 64*).

Table 64. Variables/interactions detected by stepwise selection

Variables/interactions included	Variables excluded
1. *Took MCCEE*	1. *Gender*
2. *Age*	2. *Region of origin*
3. *Time from entry*	3. *Citizenship status*
4. *Took MCCQE1*	4. *Region of education*
	5. *Took CE1*

Took CE1 did not meet the criteria to stay in the model, and it was not included. It was however still important to keep *gender, citizenship status,* and either *region of origin* or *region of education* in the model, even though they were not significant at the 0.05 level to stay in the model. This was because in the literature, models included these or similar variables, and it was important to control for them as potential confounders. No two-way interactions met the 0.05 significance criterion via testing by stepwise selection.

Since *region of origin* and *region of education* were expected to be collinear, that is most IMGs born in a country would also study medicine in that or a neighbouring country, it was important either one or the other (*Table 65*). The notable exception was North America and Western Europe, where many with that *region of origin* completed their medical education abroad (*Table 65*). If, nonetheless, *region of origin* and *region of education* were found not to be collinear, they could both be included in final model.

Table 65. Percent of IMGs who studied in region of origin

Region of origin	Percent who studied in region of origin (%)
Africa	90.8
Caribbean, C/S America	94.8
East Asia	94.6
Eastern Europe	98.4
North America, Western Europe	47.1
South Asia	88.6
Southeast Asia	93.3
West Asia	89.7

Collinearity was detected by Spearman rank correlation coefficients (*Table 66*).

Table 66. Spearman rank correlation coefficients (N=2413)

Variable	#	1	2	3	4	5	6	7	8	9
Gender	1	1.000	0.121	0.118	0.006	-0.149	-0.018	-0.050	-0.081	-0.121
Age	2	0.121	1.000	-0.134	0.039	0.101	0.038	-0.101	-0.036	-0.055
Citizenship status	3	0.118	-0.134	1.000	0.034	-0.565	0.043	-0.181	-0.171	-0.166
Region of origin	4	0.006	0.039	0.034	1.000	-0.054	0.854	-0.021	-0.171	-0.166
Time from entry	5	-0.149	0.101	-0.565	-0.054	1.000	-0.060	0.258	0.267	0.232
Region of education	6	-0.018	0.038	0.043	0.854	-0.060	1.000	-0.015	-0.022	0.003
Took MCCEE	7	-0.050	-0.101	-0.181	-0.022	0.258	-0.015	1.000	0.717	0.486
Took MCCQE1	8	-0.081	-0.036	-0.171	-0.036	0.267	-0.022	0.717	1.000	0.667
Took CE1	9	-0.121	-0.055	-0.166	-0.012	0.232	0.003	0.486	0.667	1.000

The variables with the greatest Spearman correlations were: *region of origin* and *region of education* (0.854); *Took MCCEE* and *Took MCCQE1* (0.717); and *Took MCCQE1* and *took CE1* (0.667). Moderate levels of correlations included: *time from entry* and

citizenship status (0.565) and *Took CE1* and *Took MCCEE* (0.486). Due to the expected high correlation between *region of origin* and *region of education*, the model will include only one or the other variable. The same was true for *Took MCCEE* and *Took MCCQE1* –only one can be included in the model at a time. *Took CE1* had been taken out of the model by stepwise selection so it did not pose a problem. There was only a moderate collinearity between *time from entry* and *citizenship status*, which was not problematic, even if both terms were included in the model.

Since it was important to find out if there were any major differences between models by including *region or origin* or *region of education* and *Took MCCEE* or *Took MCCQE1* due to the collinearity problems, models were created and *Type 3 Analysis of Effects* computed and p-values compared for each variable (*Table 67*).

Table 67. Models created to compare region of origin/education*

Variable	Model 1	Model 2	Model 3	Model 4
Gender	✓	✓	✓	✓
Age	✓	✓	✓	✓
Citizenship status	✓	✓	✓	✓
Region of origin	✓	✓		
Time from entry	✓	✓	✓	✓
Region of education			✓	✓
Took MCCEE	✓		✓	
Took MCCQE1		✓		✓

* ✓ indicates variable was used in that model.

It did not appear there were particularly large differences between p-values between model 1 (excluding *Took MCCQE1* and *region of education*), model 2 (excluding *Took MCCEE* and *region of education*), model 3 (excluding *Took MCCQE1* and *region of origin*) and model 4 (excluding *Took MCCEE* and *region of origin*) (*Table 68*). *Gender* and *citizenship status* not significant in any model, but were kept as control variables. It was decided therefore that the final model would contain only *region of origin* and *Took MCCEE* (model 1), since they were selected by stepwise methods and to avoid collinearity.

Table 68. Type 3 Analysis of Effects compared for each Cox model (N=2413)

Variable	Model 1	Model 2	Model 3	Model 4
Gender	0.7381	0.9396	0.9178	0.5661
Age	<0.0001	<0.0001	<0.0001	<0.0001
Citizenship status	0.5319	0.3689	0.4658	0.2473
Region of origin	0.0005	<0.0001	-	-
Time from entry	<0.0001	<0.0001	<0.0001	<0.0001
Region of education	-	-	0.0001	<0.0001
Took MCCEE	<0.0001	-	<0.0001	-
Took MCCQE1	-	<0.0001	-	<0.0001

5.5.3. Assessment of the model

There were three underlying assumptions of the Cox Proportional Hazards (PH) model: non-informative censoring, linear relation between covariates and logarithm of hazard and the proportional hazards assumption.

Non-informative censoring: For the survival analysis, the design of the study specified that IMG clients of the Access Centre who were users had survival times calculated as follows:

- *Professionally integrated*: time (in months) from registration until starting a residency position in Canada or the United States.
- *Not professionally integrated*: time (in months) from registration until study end date (April 14, 2011).

All IMG users who have not become professionally integrated by the study end date were right censored on that date. The censoring did not depend on any variable contained in the database. This satisfied the non-informative censoring criterion for the Cox model.

Linear relation between covariates and logarithm of hazard: For a Cox PH model to be fit, this assumption must hold. For it to be verified, models were created omitting each variable of interest one at a time and Martingale residuals were calculated; those residuals were plotted versus the analyzed variable. For each of the variables under consideration, a straight-line relationship was found and the assumption was therefore satisfied.

Proportional hazards assumption: The PH assumption holds that hazard functions were multiplicatively related, in which their ratio was constant over survival time (Hosmer and Lemeshow, 1999). If the PH assumption was satisfied, then there was evidence for goodness of fit for the model. If certain variables do not satisfy the PH assumption, the Cox

model can incorporate nonproportional hazards by allowing time-dependent covariates, which change at different rates for different individuals, making their hazard ratios non-constant (Allison, 2010). Time-dependent covariates in the model were really interaction terms of each of those variables with (survival) time.

One way to test the PH assumption was to use an empirical score process based on Martingale residuals for each covariate. This was also called a Supremum (or Kolmogorow-Smirnov type) test and generated 1,000 simulated paths (Allison, 2010). If the p-value was non-significant, this meant that observed process did not differ enough from the simulated process to produce a deviation from the PH assumption. The Supremum test showed that all variables except for *Took MCCEE* and *Took MCCQE1* meet the PH assumption (*Table 69*). This implies these variables may need to be included as time-dependent covariates in the model. If not, then the effects of *Took MCCEE* and *Took MCCQE1* would be their averaged effects over the range of (survival) times observed for the data.

Table 69. Supremum test summary (N=2413)

Variable	p
Gender	0.2570
Age	0.1340
Region of origin	0.4730
Citizenship status	0.7340
Time from entry	0.3760
Urban status	0.0590
City type	0.1090
Region of education	0.5030
Took MCCEE	0.0020
Took MCCQE1	0.0010
Took CE1	0.9090

Another way to test the PH assumption was to use Schoenfeld residuals. The result using Martingale residuals (above) was confirmed by results using Schoenfeld residuals.

The proportional hazards assumption was violated for the variables *Took MCCEE* and *Took MCCQE1* (nonproportional hazards). To avoid this problem, two approaches could be used: incorporating *Took MCCEE* and *Took MCCQE1* as interactions with time (time-varying covariates), and stratifying by *Took MCCEE* or *Took MCCQE1*.

Time-varying covariates: *Took MCCEE* and *Took MCCQE1* were incorporated as

interactions with time. The main effect had a hazard ratio (HR) of 22.242 with 95% CI: 9.545, 51.826, and the interaction had a HR of 0.943 with 95% CI: 0.913, 0.974. Despite the p-value showing significance, the HR for the interaction term and 95% confidence intervals (CI) were very close to 1, although still significant.

To see if the interaction stayed significant over the time from registration until integration outcome (survival time, *T*), the interaction term was set up with survival time being greater than a certain time, t_0 (e.g. *Took MCCEE**($T>t_0$)) and tested. *Took MCCEE* was found to be significant over all survival time, but the interaction of *Took MCCEE* and *Survival Time* was not significant or threshold non-significant (0.05 level) in some cases. This was most likely because the interaction had the most effect in a range of survival times, say between 35-45 months. Since both main effect and interaction terms were significant when survival time was not broken up into greater than or less than t_0, then both should be included in the model to account for nonproportionality. The estimated HR for *Took MCCEE**, taking into account the interaction would simply be the multiplication of their hazard ratios (e.g. 22.242 x 0.943 = 20.974) with a 95% CI: 8.715, 50.479. The interaction term did not have a substantial effect on the HR of *Took MCCEE*, but it was nonetheless important to take into account this nonproportionality.

Stratification: Another approach to address nonproportionality was to stratify by the violating variable. Stratification as programmed into the SAS software for the Cox regression model and involves constructing separate partial likelihood functions for *Took MCCEE* (yes and no), multiplying these functions together and choosing values of the coefficients that maximize the functions (Allison, 2010). This method is most useful for categorical nuisance variables that are not really of interest. In this case, the variables were of direct interest and stratification was therefore not appropriate, even if possible. Also, stratification does not provide estimates for the stratifying variable; does not allow for the testing of the interaction of the stratifying variable with time; and provides less efficient estimates of the coefficients than the interaction method (Allison, 2010).

It was also important to identify influential points and/or poor fitted subjects by each survival model (regression diagnostics). Outliers and influential points were detected by: *deviance residuals* (or Martingale or Cox-Snell residuals, of which deviance residuals were a transformation thereof), *Schoenfeld residuals* that differ with each covariate, plotting

likelihood displacement statistics vs. *Martingale residuals* that approximate a change in logarithm of partial likelihood function after exclusion of the i^{th} subject from the sample, and plotting the *L-Max statistics* vs. *Martingale residuals* that show the eigenvector connected with the highest eigenvalue. All graphs used to identify outliers are located in the *Appendix*.

By plotting deviance residuals for: *gender*, *age*, *time from entry*, *citizenship status*, *region of origin*, and *Took MCCEE*, it was found that none of the observations were clear outliers. By plotting Schoenfeld residuals for: *gender*, *age*, *time from entry*, *citizenship status*, *region of origin*, and *Took MCCEE*, as a function of time, it was found that none of the covariates departed from the proportionality assumption except for *Took MCCEE*, confirming previous results. The plot of *likelihood displacement statistics* vs. *Martingale residuals* also did not show evidence of outliers or influential points. Although at first glance it appears that a small number of points lie outside the spread of the data, the y-axis scale was so small that these deviations were not noticeable. The plot of the *L-Max statistics* vs. *Martingale residuals* also did not show evidence of outliers or influential points.

5.5.4. Final model presentation

After describing the survival data by professional integration outcomes; developing the model through initial selection of covariates, univariate analysis using the log-rank test, stepwise selection, collinearity checks, and comparing models; and finally assessing the adequacy of the model by checking assumptions of the Cox Proportional Hazards (PH) model and diagnostics, a final model could be reported.

Table 70. Variables/interactions included

Variables/interactions included	
1. *Citizenship status* 2. *Region of origin* 3. *Gender* 4. *Time from entry* 5. *Age* 6. *Took MCCEE*	1. Interaction of *Took MCCEE* and *survival time*

The survival model was modeling time to professional integration outcome. The final set of covariates and interactions in the model are reported (*Table 70*). Since there was one

factor that did not meet the proportionality assumption, an interaction term with survival time was included making that part of the model an extension of the Cox PH model that includes nonproportional hazards.

The parameter estimates, standard errors and p-values for the main effects of the survival model are presented (*Table 71*).

Table 71. Main effects parameter estimates of survival model

Variable	Variable category	Parameter Estimate	Standard Error	p
Gender	Female (ref.)			
	Male	-0.03578	0.12776	0.7794
Age (years)	30-39 (ref.)			
	Under 30	0.37298	0.14116	0.0082
	40-49	-0.78922	0.17065	<0.0001
	50 and over	-2.29683	0.58834	<0.0001
Region of origin	North America, Western Europe (ref.)			
	Africa	-0.85671	0.31585	0.0067
	Caribbean, C/S America	-0.20245	0.3309	0.5407
	East Asia	-0.77078	0.40584	0.0575
	Eastern Europe	-0.67623	0.32236	0.0359
	South Asia	-0.61584	0.26634	0.0208
	Southeast Asia	-0.23159	0.44039	0.5990
	West Asia	-0.44350	0.2875	0.1229
	Not answered	0.77232	0.41661	0.0638
Citizenship status	Canadian Citizen (ref.)			
	Permanent Resident	-0.18543	0.16024	0.2472
	Temporary Resident	-0.65741	0.48847	0.1783
	Other/ not answered	-0.29065	0.4200	0.4889
Time from entry	Less than 1 Year (ref.)			
	1-5 Years	0.86220	0.16309	<0.0001
	5-10 Years	1.08785	0.22376	<0.0001
	Over 10 Years	0.88357	0.28867	0.0022
	Not answered	1.84835	0.37646	<0.0001
Interaction of Took MCCEE and survival time		-0.05841	0.01648	0.0004

Since the interaction between *Took MCCEE* and *survival time* was kept in the model, the effect of *Took MCCEE* can be multiplied by the effect for the interaction to find an

estimated effect over all survival time. The table of hazard ratios was presented (*Table 72*). The term hazard can be meant to signify "risk" or "chances of", in a certain time.

Table 72. Hazard ratios for final model (N=2,413)

Variable	**Hazard ratio [95% confidence interval]**	**Interpretation** (hazard of professional integration)
Gender		
Women	Reference	
Men	0.965 [0.751, 1.239]	No difference
Age		
30-39 years	Reference	
Under 30 years	1.452 [1.101, 1.915]	Almost 1½x the hazard
40-49 years	0.454 [0.325, 0.635]	Almost ½x the hazard
50 and over years	0.101 [0.032, 0.319]	About $^{1}/_{10}$x the hazard
Region of origin		
North America, Western Europe	Reference	
Africa	0.425 [0.229, 0.788]	Almost ½x the hazard
Caribbean, C/S America	0.817 [0.427, 1.562]	No difference
East Asia	0.463 [0.209, 1.025]	No difference
Eastern Europe	0.509 [0.270, 0.957]	About ½x the hazard
South Asia	0.540 [0.321, 0.910]	Over ½x the hazard
Southeast Asia	0.793 [0.335, 1.881]	No difference
West Asia	0.642 [0.365, 1.127]	No difference
Not answered	2.165 [0.957, 4.898]	Over 2x the hazard
Citizenship status		
Canadian Citizen	Reference	
Permanent Resident	0.831 [0.607, 1.137]	No difference
Temporary Resident	0.518 [0.199, 1.350]	No difference
Other/ not answered	0.748 [0.328, 1.703]	No difference
Time from entry		
Less than 1 year	Reference	
1-5 years	2.368 [1.720, 3.260]	Over 2x the hazard
5-10 years	2.968 [1.914, 4.602]	About 3x the hazard
Over 10 years	2.420 [1.374, 4.260]	Almost 2½x the hazard
Not answered	6.349 [3.036, 13.279]	Over 6x the hazard
Took MCCEE		
No	Reference	
Yes	22.193 [9.534, 51.664]	Over 22x the hazard
Interaction of Took MCCEE and survival time	0.943 [0.913, 0.974]	-

For *gender*, IMGs who were men did not have a significant hazard ratio, or no

difference was detected between men and women (reference category) with regards to the 'hazard' of securing a residency position in Canada or the US over time (*Figure 33*). This variable was left in the model as a control factor to account for unobserved heterogeneity.

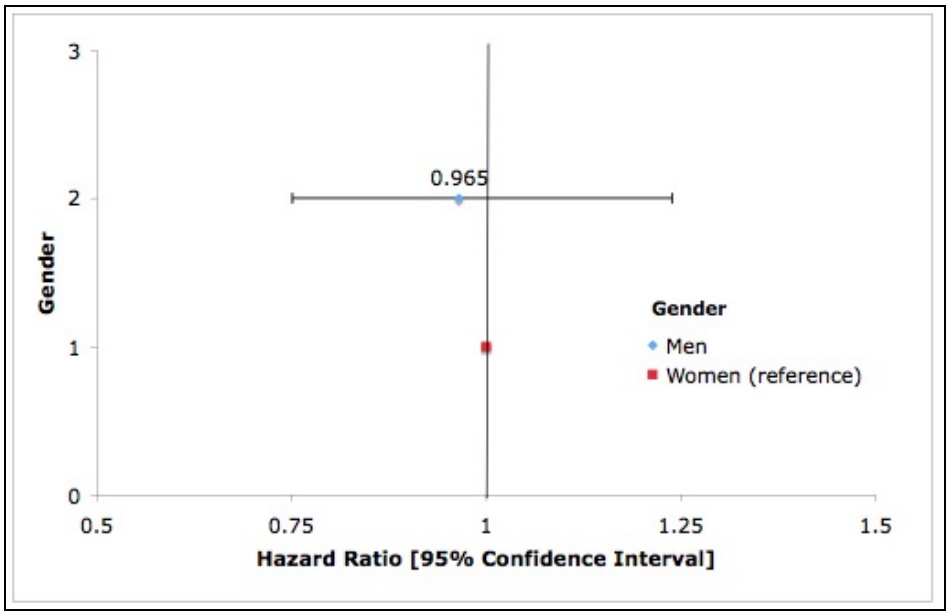

Figure 33. Hazard ratio [95% confidence interval] for gender (N=2413)

IMGs who were under 30 years old had 45% greater hazards than those 30-39 years old (*Figure 34*). Those 40-49 years old had 54% lower hazards than those 30-39 years old. IMGs 50 and over had 90% lower hazards than those 30-39 years old. All HRs were significant, with the 95% CI for the HR for 50 and over being wider and more imprecise than that for the other *age* groups.

IMGs from most *regions of origin* did not have significantly different hazards than those from North America, Western Europe (*Figure 26*). The exceptions were: Africa, with 57% lower hazards, Eastern Europe with 49% lower hazards, and South Asia with 46% lower hazards. *Figure 35* shows HRs for *region of origin* with the exception of the 'not answered' category, which had an exceptionally large imprecise 95% confidence interval that contains '1', which was not significantly different from North America, Western Europe.

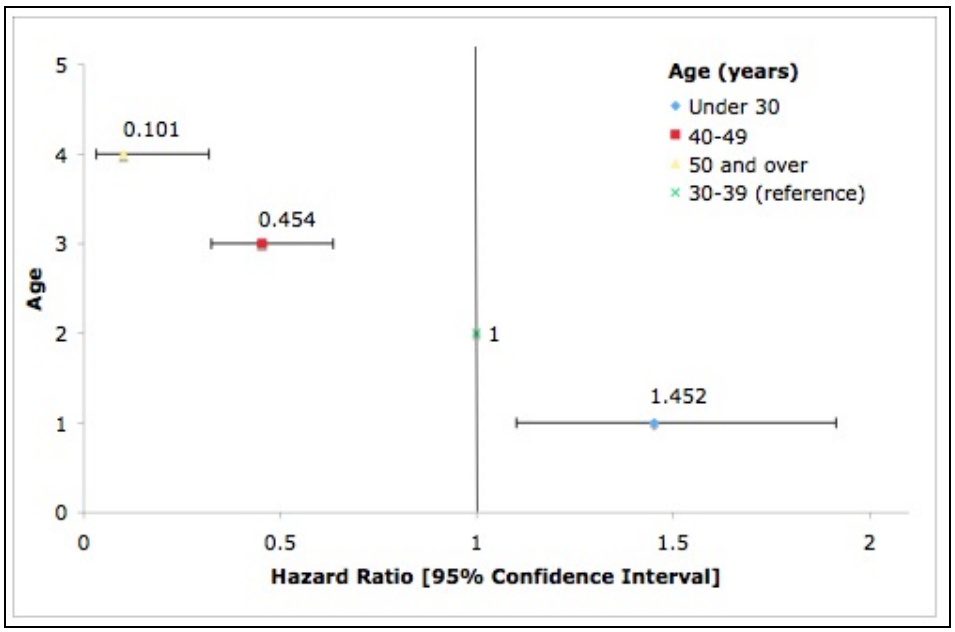

Figure 34. Hazard ratios [95% confidence intervals] for age (N=2,413)

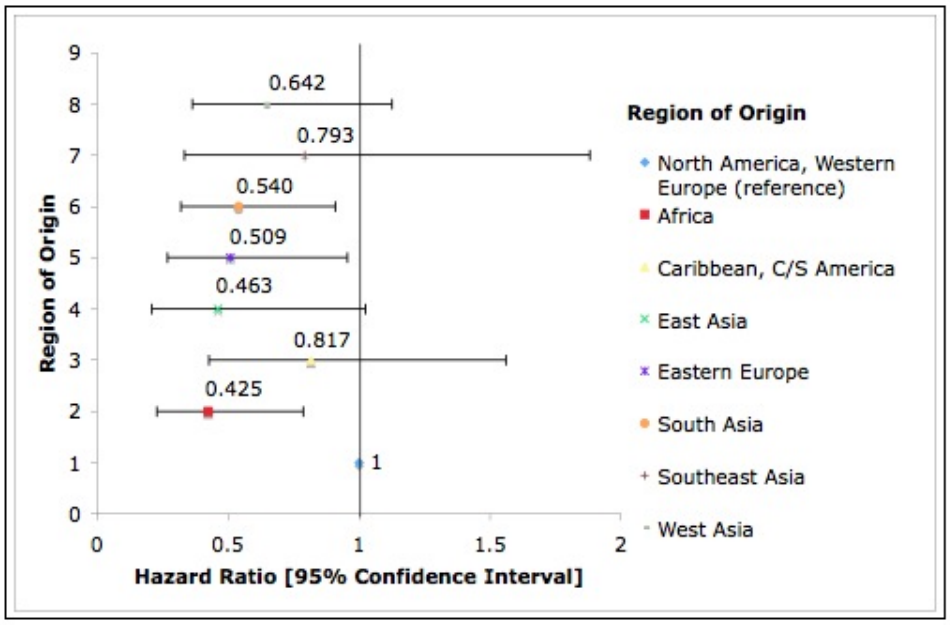

Figure 35. Hazard ratios [95% confidence intervals] for region of origin (N=2,413)

IMGs with any *citizenship status* did not have significantly different 'hazards' of professional integration from those with Canadian citizenship status, which was the reference category, with regards to the 'hazard' of professional integration (*Figure 36*). This variable was left in the model to account for unobserved heterogeneity or as a control factor.

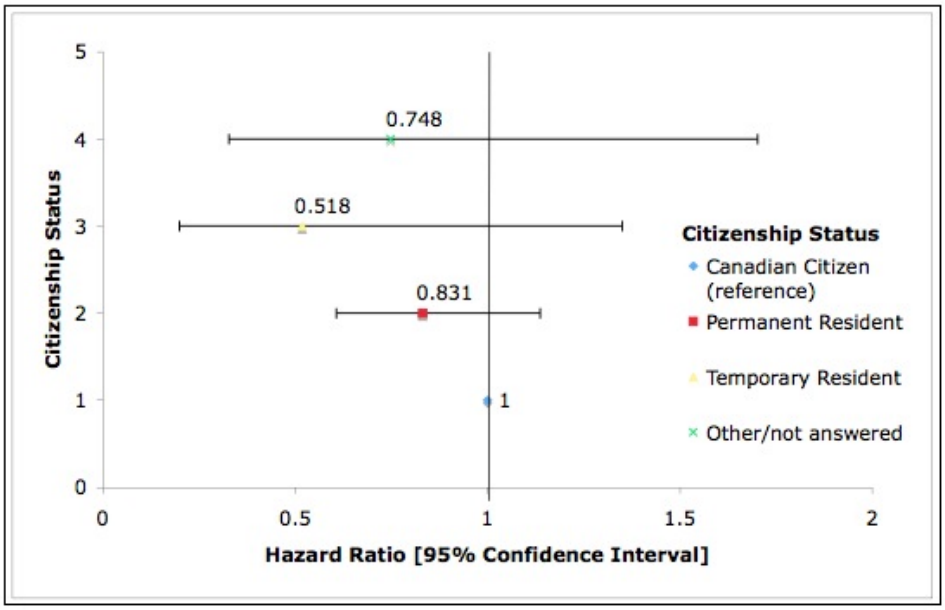

Figure 36. Hazard ratios [95% confidence intervals] for citizenship status (N=2,413)

Hazard ratios for IMGs who have been in Canada 1-5 years, 5-10 years, and over 10 years were all over '2'. This meant that these IMGs had over twice the 'hazard' of professional integration as IMGs who have been in Canada less than 1 year. It appears that for IMGs who have been in Canada 5-10 years, they had the greatest hazard ratio at almost three times that of less than 1 year for those three groups. For IMGs who did not answer the question on *time from entry*, they had a six times greater 'hazards' than those who have been in Canada less than 1 year, but not much more can be said about this group, except that they preferred not to answer this question. *Figure 37* does not show the 'not answered' category, which had an exceptionally large imprecise 95% confidence interval, as well.

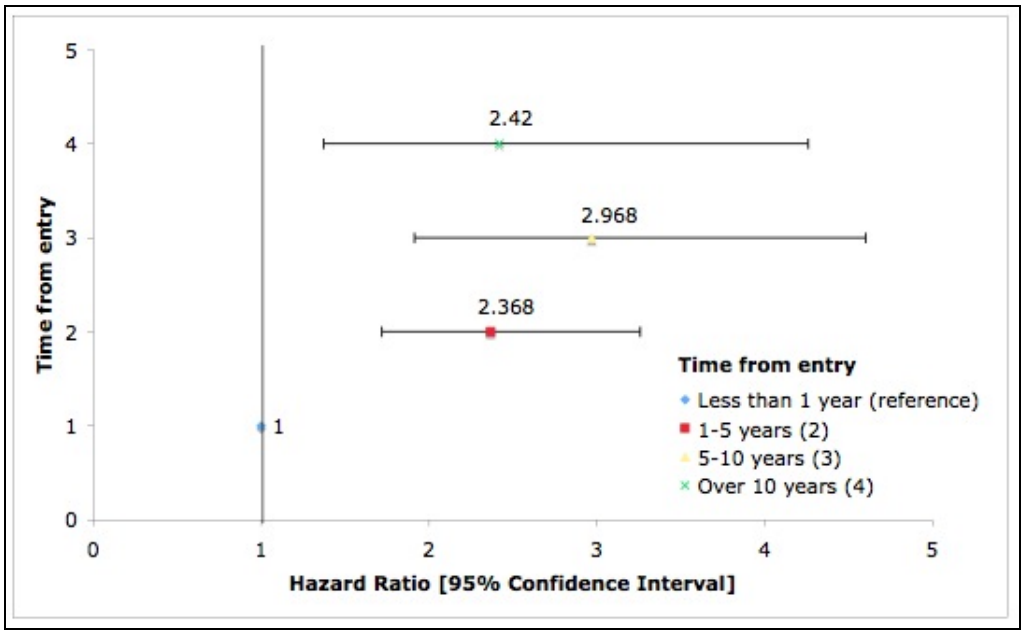

Figure 37. Hazard ratios [95% confidence intervals] for time from entry (N=2,413)

For IMGs who took the MCCEE exam, they had a 22 times greater 'hazard' of professional integration than those who did not. This was not surprising because the MCCEE was one of the requirements to enter residency in Canada, but it must be stressed that professional integration outcomes were of IMGs securing positions in Canada or the United States. Even by taking the interaction term into account, the hazard ratio remains over 20 times greater for those who took the MCCEE.

6. DISCUSSION & CONCLUSION

The objectives of this thesis were to describe a sample of IMGs by variables recorded in the Access Centre database and to analyze two principal research questions with regards to IMGs registered at the Access Centre in Ontario. The research questions were related to the factors associated with baseline employment status and professional integration outcomes of IMGs, respectively. These objectives were met by obtaining largely self-reported data from IMGs who registered at the Access Centre, by conducting descriptive analyses, by using logistic regression in a cross-sectional study design and by using Cox Proportion Hazards regression in a cohort study design. This project advances the knowledge regarding IMGs in Ontario, showcasing trends such as high unemployment rates among IMGs registered at the Access Centre. It builds upon previous work that described licensed and unlicensed IMGs living in Canada by way of the 2001 Census [10, 12, 13], using similar or analogous variables, but with a specific focus on Ontario and those in the process of labour market and professional integration. This study should fuel further study in the area of integration of IMGs into Canada's provincial and territorial health care systems.

6.1. Objective ① - Descriptions of IMGs by variables in Access Centre database

There were some intriguing results of the descriptive analysis of all IMGs (n=8373) who registered at the Access Centre between January 1, 2007 and April 14, 2011 (section 5.1). Given that IMGs registered at the Access Centre are in process of becoming settled, adapted, and at various stages of the medical licensure process, it was still somewhat surprising that over 60% did not use the services beyond initial registration. This may be due to a number of factors, such as already having enough information and resources with regard to the licensure process, not being ready, able or have the time to attend sessions or speak with staff at the centre, or not be interested in the services offered in their current formats. This could perhaps be interpreted as indicating that users of the services at the Access Centre are those in most need.

With regards to demographics, we found that there were roughly equal numbers of men and women, with slightly more men using the centre, which could be indicative of

gender differences or cultural differences in which women may have family or other responsibilities and have less time to access the services than men, as an example. This has been noted in the literature on the professional integration of internationally educated health professionals [6].

Given that there was a normal distribution of ages with the greatest number of registrants in the 40-49 year old category, it can be hypothesized that many IMGs have not only completed medical school in their countries or regions of origin, but that many have also completed some form of residency or internship as well and that many have actively worked as physicians for a number of years before coming to Canada. In addition, it appears that the largest number of IMGs have completed their degrees at least 15 years before registering. This finding speaks to the fact that these are not fresh graduates of foreign medical schools, and this may make it difficult for them to take entry-level MCC exams. But it is also unfortunate that the medical licensing process in Canada does not recognize residency training outside of Canada, the US and 29 jurisdictions designated by the Royal College of Physicians and Surgeons of Canada (which are in current or former Commonwealth countries). In addition, the many years of experience and the expertise of IMGs after completion of residency are not recognized as well. Therefore, IMGs registered at the Access Centre represent a great, untapped potential.

The only previous studies that have analyzed IMGs in a similar fashion to those in this study were those that looked at the 2001 Census of Canada data. Their analyses, however, are of all of Canada (both those integrated and those not), while the current one is only of Ontario and largely focused on those IMGs who are not yet integrated. A comparison is made here between the current findings and those using the 2001 Census data, given different time period and populations. It appears that there was a comparatively greater amount of somewhat younger IMGs who registered at the Access Centre compared with the 2001 Census data (*Figure 38*) as analyzed by Boyd and Schellenberg (2007 and 2009) [10, 13]. This may be due to the fact that the centre is relatively new, but also that as IMGs age, their chances decrease of securing residency positions and making it through the medical licensing process. In effect, older IMGs could potentially be less likely to register, since they may not have heard of the centre, probably being in Canada a longer time, and many may have given up on medicine altogether. Another reason could be that older IMGs are also more likely to

be working full-time (but not as doctors), with younger IMGs more likely to be not working and searching for help with the licensing process and/or career advice.

It is not surprising that the largest number of IMGs at the Access Centre was from South Asia (mostly from India), since the top source country for IMGs in the 2000s was India [9] (*Table 24*). Since the Access Centre is physically located in Toronto, it is also true that the Greater Toronto Area as the greatest South Asian population in Canada, which may also contribute to this result. Boyd and Schellenberg (2007 and 2009) [10, 13] used the same categories of region of origin in their analysis and a direct comparison was made by way of a bar graph (*Figure 38*). The differences in the numbers of IMGs who register by region of origin may be reflective of the wave of new immigrants, but also of the fact that the Access Centre is very new. The Access Centre has most likely captured more recent immigrants who predominantly come from South Asia, while the Census data contains IMGs who have been in Canada much longer (who arrived many years before the year 2000), which reflects many more IMGs from Western Europe.

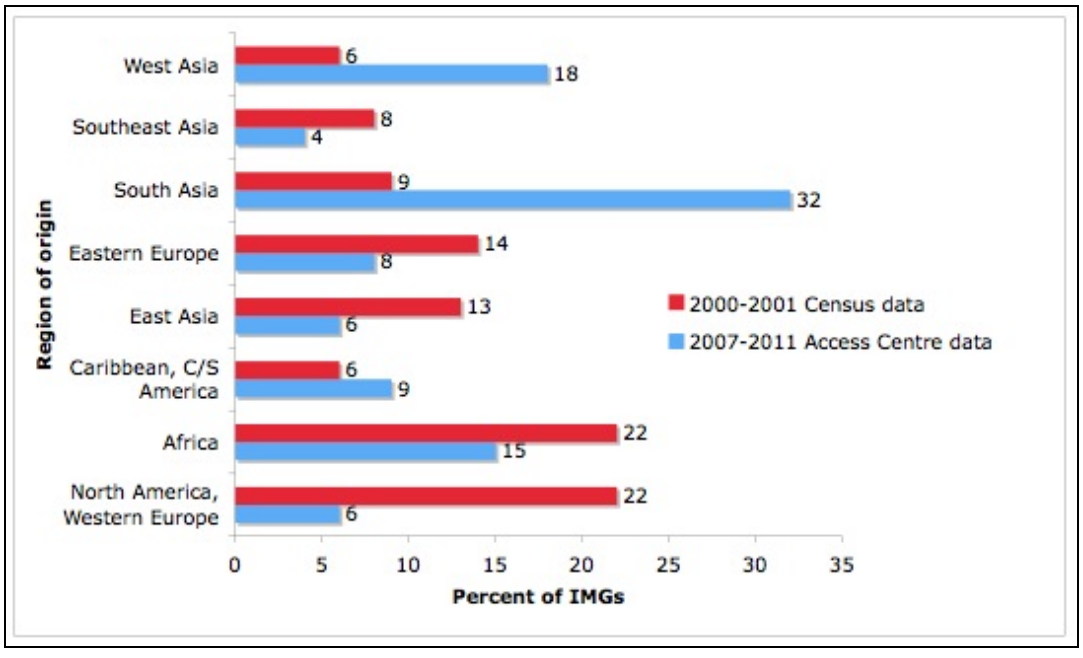

Figure 38. Percent of IMGs by region of origin by Access Centre and Census data

Given that much fewer IMGs at the Access Centre speak an official language as a first language spoken compared to more than half of IMGs speaking an official language at

home (Boyd and Schellenberg (2007 and 2009) [10, 13], it showcases that the IMGs that have come to the Access Centre are probably more recent immigrants than those that are reported in the earlier Census data and those most in need of the services provided by the Access Centre. Although the variables are slightly different, nonetheless the comparison is interesting to make; the Census data is indicative of IMGs wanting to integrate themselves and their families by way of language, but most likely for many it is their second or even third language.

IMGs registered at the Access Centre generally tended to be more recent arrivals compared to the 2001 Census data [12] and this study therefore captures IMGs at a critical time period in their pathways to professional integration or alternate education, training or employment. Although, it must be noted that slightly different period of arrival brackets were employed by McDonald et al. (2009). Since the Access Centre is relatively new, more recent arrivals may have gotten information about it before, on, or after arrival at some points along the process of obtaining information on being able to practice medicine in Canada.

Both the current and 2001 datasets point to IMGs living in large urban areas in Canada where there are more sizeable immigrant populations from around the world. This allows for the creation of support networks and smoother adaptation with people from the IMG's region of origin and education.

In the literature, a drop in earnings potential of many recent immigrants is described for both physicians and non-physicians [7, 8], and also documented in foreign-born physicians by McDonald et al. (2009) in their analysis of 2001 Census data [12]. The current analyses corroborates those findings where Access Centre data indicates that 32% of IMGs (as a household) earned $1-19,999 per year, with 9% earning $20-29,999, 7% earning $30-39,999 (31% of IMGs did not answer this sensitive question). This is similar to McDonald et al. (2009) who found that foreign-born physicians not working as doctors in Canada were earning on average $39,495 per year (median: $19,421 per year) [12]. In addition, the Access Centre data shows that only 8% of IMGs were living alone, while most IMGs lived with at least one, two or three other people. Neither Boyd and Schellenberg (2007 and 2009) nor McDonald et al. (2009) included a variable for the number of people in household [10, 12, and 13]. This is a disturbing finding since with such small household incomes, on average, IMG's have to support their families, including wives and/or children, but it is important to keep in

mind that many IMGs will be living off assets they brought with them to Canada.

As a result of the Access Centre being very new and having a younger population of more recent arrivals of IMGs, it is not surprising that slightly over half of them were permanent residents. This is in contrast to Census data [13], which showed slightly over half of IMGs being Canadian citizens. This is indicative of the fact that Census data has captured IMGs who are older, and settled in Canada for a longer period of time.

Since the United States and Western European countries have similar medical education systems taught predominantly in English or French, it was no surprise that only a very small portion of IMGs with those regions of origin and education were represented at the Access Centre. This is most likely because they were able to secure residency positions with greater ease, without the need to use the Access Centre. To highlight this point, the vast majority of IMGs (92.5%) who registered at the Access Centre completed their medical education outside of North America or Western Europe. Given that an IMG is defined as completing their medical education outside of Canada, the closest comparison were IMGs who completed their MD degree in the US or Western Europe. In particular, McDonald et al. (2009) recorded a *location of medical education* variable, where 77% of foreign-born physicians not working as doctors in Canada completed their medical educated outside Canada, while 8% completed it in Canada, and 15% had an unknown location of medical education [12].

There appears to be a much larger percentage of IMGs not employed, registered at the Access Centre, than IMGs with no occupation stated in the Census data. These speak to the fact that the data from the Access Centre is more recent. And also that a great number of IMGs are not only not working as doctors and many IMGs are not working at all. On the other hand, McDonald et al. (2009) did not investigate full-time, part-time/casual or not employed status [12] as was noted in the Access database.

A series of variables not recorded in the 2001 Census, but reported in the Access Centre data were those related to whether IMGs took certain licensing examinations and their date of graduation or time since completion of medical school. The Access Centre helps IMGs at all stages of their career pathways. Therefore, it is not entirely surprising that the majority (70%) have not yet taken the MCCEE exam or the even greater percentage (82%) that have not yet taken the MCCQE1 exam. The NAC OSCE replaces the CE1 exam in 2011

and is taken account in the selection of candidates for residency positions in some jurisdictions, but intends to be harmonized and nationalized in the near future. Variables recording whether IMGs took the US medical licensing exams (USMLE Steps 1, 2, and 3) were not available for this analysis. The Access Centre can direct such IMGs to resources to help prepare for the Canadian exams as well as ascertain whether IMGs would be eligible to take the USMLE exams, or to preparation courses, where to register, as well as to personal matters such as managing preparation and taking care of a family, for instance. Some IMGs may want to pursue alternate career paths, so this centre is perfect to give them a head start.

Just by visiting the CaRMS website and reviewing their statistics it is revealed that obtaining a residency spot for an IMG in Canada is a challenge when there are so many applying and so few matching. It is therefore not unheard of that just under 5% of all registered IMGs at the Access Centre would obtain residency positions, with about $^{2}/_{3}$ of those filled in Canada and $^{1}/_{3}$ of those filled in the US. Then again, many IMGs were either ineligible to apply in Canada (e.g. have not taken the MCCEE exam) or did not apply in Canada, but only to the US residency match. This is because the US is a larger, more populous country than Canada with a greater number of residency positions, and also more opportunities for IMGs.

In the same period (2007-2011), 1,400 IMGs matched in the 1st iteration through the CaRMS match (averaging 280 per year) and 403 IMGs matched in the 2nd iteration (averaging 80 per year), to total 1,803 IMGs matching in Canada. It is therefore apparent that this study has captured only a fraction of successful CaRMS applicants. What this study has to offer is that it showcases the characteristics of unlicensed IMGs who are just about to enter the licensing pathway. While the IMG Database Project at CAPER is a national longitudinal database that is being developed to track IMGs from medical assessment (through the MCC exams) through residency training to practice, this study has captured many IMGs who have not even registered to take the MCC exams as of yet. It is also notable that neither CaRMS nor Statistics Canada (with respect to the Census) is on the list of organizations collaborating on the IMG Database Project. If, for example, the CaRMS and Census data could be added to that list, even more unanswered questions about unlicensed and unsuccessful IMGs could be answered –and contrasted to those who were successful (at various stages of the licensing process).

It is in no way a requirement for IMGs to register at the Access Centre in order to apply for residency positions in Canada (or the US). The Access Centre is a fairly new undertaking that has been very helpful to IMGs, even if only a small fraction of successful CaRMS applicants are IMGs who have used its services. Since it is relatively new, many have not heard about it, and many IMGs who are successful in CaRMS may not have needed the extra assistance from the Centre. In any case, the Access Centre has helped some IMGs and is providing services that may help a large population that may be the ones most in need of such services.

In sum, the key take away points for Objective 1 include:

- The results confirmed some earlier findings, but some differed because of the focus on the more recent context in Ontario.
- A generally younger population of more recent arrivals, with a great number from South Asia, registered at the Access Centre, indicative of a new wave of immigrants from that region of origin who are in the process of labour market and/or professional integration.
- IMGs captured in the database of the Access Centre reflect less favourable labour market conditions with respect to employment status, compared to IMGs with no occupation stated in the 2001 Census data.
- IMGs securing residency positions, amounted to less than 5%, which indicates IMGs are at generally earlier stages of the licensing process, and with the centre being relatively new (so many IMGs have not yet had enough time to apply and secure positions).

6.2. Objective ② - Analysis of two principal research questions

After a discussion of the trends in the data on IMG registrants, this discussion follows the two principal research questions: the first on baseline employment status and the second on professional integration outcomes of IMGs.

6.2.1. Baseline employment status

Methodologically, the stepwise selection with logistic regression was an excellent tool to use to identify significant predictors and/or interactions with respect to baseline employment status. It is reassuring that covariates found to be significant in our analysis are similar to those found in previous analyses. In particular, factors that were significantly associated with full-time (vs. not full-time) employment status, at baseline for IMGs registered at the Access Centre, were: *citizenship status, region of origin, gender, time from entry,* and *age*. A non-significant factor that was controlled for and included in the model was *first language spoken (is official language)*. Significant interactions in the present model included: *gender* and *age*; *gender* and *time from entry*; *age* and *region of origin*; and *region of origin* and *time from entry*. Similar covariates were found to be significant by McDonald et al. (2009) [(12)], regarding the occupation of employment of MD holders in Canada: *gender, arrival period, region of birth, immigration status,* and *language spoken at home*. For instance McDonald et al. (2009) reported that female foreign-born doctors had 61% greater 'risk' of being unemployed (vs. working as a doctor) as male IMGs.

Whereas the current logistic regression for full-time (vs. not full-time) employment status yielded many interactions using the Access Centre data, interpretation was most useful when more than one variable category was specified. An example is that men, under 30 years old who have been in Canada for 1-5 years had twice the odds of full-time (vs. not full-time) employment as women, under 30 years old who have been in Canada for 1-5 years. This could speak the childbearing and childrearing issues in this age cohort. In general, no difference between IMGs who were men or women was reported keeping *age* and *time from entry* categories constant. For those comparisons that were significant, such as the one described above, men always had greater odds of full-time (vs. not full-time) employment as women. This result can be thought of as analogous to women having a greater risk of unemployment as men in the 2001 Census data reported by McDonald et al. (2009) [(12)]. It must be noted that gender differences may also reflect different cultural norms, whereby women taken on more roles than men vis-à-vis family and household responsibilities. It is unclear whether work as a housewife for instance was reported as full-time, part-time or not employed.

The longer an IMG has been in Canada, the greater were his or her odds of full-time

(vs. not full-time) employment. This was true for IMGs from all *regions of origin*, with the exception of IMGs from North America, or Western Europe (where no difference was detected). These findings are similar to those of McDonald et al. (2009) regarding *period of arrival*, where more recent arrivals had significantly greater risks of unemployment (than working as a doctor) [(12)]. Obtaining employment may be less of a problem for IMGs from Western Europe or North America, no matter their period of arrival.

Logistic regression using Access Centre data showed that temporary residents did not show a significant difference in the odds of working full-time (vs. not full-time). This contrasts with McDonald et al. (2009) who reported that temporary residents (compared to Canadian citizens) had almost 6½ greater risks of unemployment than working as doctors in Canada [(12)]. The discrepancy in these findings may simply show that there were very few temporary residents in the current dataset compared to the Census, and with a greater sample size (with more temporary residents), something could be potentially detected.

While McDonald et al. (2009) found that speaking a language other than English or French at home was associated with greater risks of unemployment (or lower skilled employment) than working as a doctor, the logistic regression ran here showed no statistical difference between those who spoke an official language first or not [(12)]. This finding is interesting since it may speak to the fact that the immigration system is working well at finding immigrants who speak one of the official languages of Canada reasonably well before letting them settle.

In the multinomial logistic regression, models for 'full-time vs. not employed' and 'part-time/casual vs. not employed' were estimated revealing similar significant covariates including: *citizenship status, region of origin, gender, time from entry, age,* and *first language spoken (is official language).* Significant interactions included: *age* and *citizenship status*; and *gender* and *region of origin*. In general, the results for regression models for full-time vs. not full-time, full-time vs. not employed and part-time/casual vs. not employed were very similar. The same covariates as the earlier logistic regression for 'full-time vs. not full-time' were found; the main difference was that fewer (and different) interactions were found to be significant.

There were clear differences between IMGs who were in full-time compared to not full-time employment by a number of covariates. For instance, a greater percentage of IMGs

who were not in full-time employment were from South Asia than the percentage of IMGs in full-time employment that was from South Asia. There may be numerous factors leading to these observations. One could be that many IMGs from South Asia (and also West Asia) are having a harder time finding full-time work. Another reason could be that these groups of IMGs prefer to work part-time or not work in order to prepare for exams or other aspects of the licensing process, and/or family obligations. It must be stressed that every situation is unique, and IMGs at the Access Centre are a mix of medical doctors who are at various stages in the licensing process or who have just arrived to Canada, were being settled, and have not yet begun the process.

In sum, the key take away points for Objective 2i include:

- Permanent residents were half as likely to be in full-time employment, which may be reflective of the fact that the sample includes IMGs who are more recent immigrants.
- IMGs did not experience a difference in employment based on their first language spoken, which may speak to their generally good language proficiency.
- In general, the longer an IMG has been in Canada, the better are their odds of full-time employment

6.2.2. Professional integration outcomes

As noted above, the term 'professional integration outcomes' was chosen to mean securing a residency position in Canada or the US, since this is the greatest hurdle in the licensing process for IMGs. It was initially assumed that once an IMG enters residency, he or she would complete it and will sit the certification exam and apply for licensure in Canada. However, after the literature search revealed that many IMGs are having trouble with the certification exam, this term is used to signify being in a more professionally integrated state and moving towards full integration (which would mean working as a doctor in Canada). Also, an IMG who enters residency is working as an MD-in-training for a small salary, and is no longer working in another, oftentimes-unrelated field, or unemployed.

Survival analysis has rarely been applied to research questions involving IMGs in

particular. However, one example is Matthews et al's (2008) physician retention/historical cohort study in Newfoundland and Labrador, which likewise used Cox regression methods to compare IMGs to CMGs as well as specifically to graduates of the Medical University of Newfoundland [51]. Therefore, this part of the study was using similar methods to study a different question to do with IMGs, this time in Ontario.

Furthermore, a univariate analysis of professional integration was used to describe the characteristics of IMG users who have and have not secured a residency position in Canada or the US, after exclusions. The only variables that were not informative (and not included in further analyses of the Access Centre data) were *city type* and *urban status*, as before.

There were clear differences between IMGs who found residency positions and IMGs who did not by a number of covariates. While more men were working full-time than women, more women were professionally integrated than men. One could speculate that if women are not working full-time, they may be studying, or have more time to participate in various stages of the licensing process and therefore may have greater easy in securing residency positions as a result. In addition, it is the younger IMGs that were predominantly (over 70%) integrated (less than 39 years old) which may speak to the fact that they have many more years of medical service available to perform in Canada compared to older IMGs. There is a greater economic benefit to the people of Canada to licensing younger IMGs than older ones, which may impact their success in securing a residency position.

It must be remembered that South Asians represent the greatest share of population of IMGs registered at the Access Centre. No doubt therefore that the greatest numbers professionally integrated could also come from that population, which happens to be the case. In terms of region of origin, the greatest number of IMGs professionally integrated came from South Asia (N=112), corresponding well with IMGs from South Asia having an 86% predicted probability of working as doctors (the highest of all regions of origin) [13] according to the 2001 Census data.

IMGs from North America, Western Europe may be more familiar with the medical licensing system in Canada than IMGs from other regions of origin. As a percent of those from North America, Western Europe, 26.5% became professionally integrated. In absolute terms, there were few IMGs from that region of origin, but as a share of their population, they outperformed the other regions of origin in terms of securing residencies. There may be

underlying factors such as the quality of medical education (not investigated here), which may contribute to this finding.

IMGs with Canadian citizenship may be more familiar with the system or may have an advantage. Given this, the finding that the greatest number of IMGs who became professionally integrated were permanent residents (N=170), but only 10% of permanent residents became professionally integrated compared to 20.7% of Canadian citizens is not surprising. There were many more permanent residents represented in the dataset than Canadian citizens, which needs to be taken into account.

It was discovered that there may be an optimal time in Canada for IMGs to become settled, pass all exams and apply and be accented for residency training. That time was found to be 1-5 years, where the majority of IMGs that became professionally integrated within that time. This points to the fact that IMGs have to work around a fairly quick turnaround time to have the greatest chances of professional integration.

A similar model-building process as for logistic regression was used for survival analysis through Cox Proportional Hazards regression. *Region of origin* was also favoured in the survival model over *region of education* due to high collinearity. Similarly, *Took MCCEE* was favoured over *Took MCCQE1* due to high collinearity. The assessment of the model showed that the assumptions for Cox Proportional Hazards regression were met, with the exception of the *Took MCCEE* variable, which had nonproportional hazards[47] and was incorporated into the model via an interaction term.

The variables included in the final model - *citizenship status, region of origin, gender, time from entry, age* and *Took MCCEE* - were significant with the exception of *gender* and *citizenship status*, which were kept in the model as controls. Similar covariates were found to be significant by McDonald et al. (2009), regarding the indicators of working as an MD in Canada: *gender, arrival period, region of birth, immigration status,* and *language spoken at home* as well the interaction of *gender* and *immigration status* (12). Although working as an MD in Canada (what McDonald et al. (2009) reported on) was not one of the outcomes

[47] Nonproportional hazards with regards to the variable *Took MCCEE* can be thought of; as the effect of *Took MCCEE* may have been weaker the longer a client has stayed at the Access Centre, for example. It signifies that the effect of *Took MCCEE* has not been constant proportional over time between those IMGs who took the exam and those who did not or effectively that the survival curves/lines crossed and we not parallel to each other over survival time.

studied, it is analogous to the factors associated with professional integration (as defined by securing a residency).

Some trends that were observed included: IMGs under 30 years old had the greatest 'hazard'[48] or risk of professional integration with older age groups having a decreased 'hazard'. This may be due to younger IMGs having more productive years ahead of them – it is more economic for Canada to admit to residency younger IMGs and then eventually have doctors working for a greater amount of years. Also, younger IMGs have also just completed medical school and have the knowledge fresh in their minds and are accustomed to taking exams- so they have greater chances of scoring better on the MCCEE, for instance.

IMGs from Africa, Eastern Europe and South Asia all had about half the 'hazard' or likelihood of professional integration as IMGs from North America or Western Europe. IMGs from these regions seem to have a more difficult time securing residency positions, which may due to a host of interrelated complex factors. One could be the quality of medical education, another could be language and cultural barriers, and others could include systematic discrimination. The exact reasons for this result cannot be elucidated from the Access Centre database. What can be said is that some IMGs from these regions of origin may be disadvantaged and require additional assistance in navigating the medical licensing process in Canada. While McDonald et al. (2009) found that South Africans had almost 7 times greater odds of working as an MD, and IMGs from the rest of Africa did not have different odds of working as an MD than the reference group (US) [(12)]. The *region of origin* variable (in the current analysis) treated Africa as a whole entity, and showed that Africans had decreased 'hazards' of integration. Also McDonald et al. (2009) documented those IMGs from the Philippines and less developed regions of East Asia both had about half the odds of working as a doctor [(12)]. On the other hand, both Southeast Asia (which includes the Philippines) and East Asia *regions of origin* in the current analysis did not have significantly different 'hazards' of professional integration compared to those from North America or Western Europe.

Also, those IMGs who have been in Canada 5-10 years had the greatest 'hazard' of professional integration. This probably speaks to an optimal period of time in Canada for an

[48] The hazard is the risk or hazard of an event. The hazard ratio is the effect of an explanatory variable on the hazard or risk of an event. It is an estimate of the relative risk in survival analysis.

IMG to have settled, gotten through most stages of the licensing process (passed all exams) that allowed them to apply and be successful in the residency match. McDonald et al. (2009) likewise reported that IMGs who have been in Canada for longer (i.e., earlier *periods of arrival*) had greater success in working as an MD in Canada [12]. McDonald et al. (2009) did not report results for *age*, instead using *age* and *age squared* solely as control factors [12].

The single greatest factor associated with securing a residency was whether an IMG had taken the MCCEE exam or not. This was because this was one of the requirements to enter residency training in Canada (while not a requirement for the US for those who obtained positions there). Given that 70% have not taken the MCCEE, IMGs should be advised to take it, even before they arrive in Canada –in order to increase their chances of success. This finding concurs with many previous recommendations, including those of Task Force 2: A Physician Human Resource Strategy for Canada [71].

In sum, the key take away points for Objective 2ii include:

- There is a small number of IMGs who registered at the Access Centre are matching to residency positions in Canada or the United States, perhaps because less than a third have completed the MCCEE exam.
- The MCCEE exam is a significant step in the licensing process and IMGs could be advised of taking this exam as soon as possible to increase their chances of success, given that this was the most significant factor.
- Younger IMGs who have been in Canada between one and five years had greater success and hazards of professional integration. The difficulty in matching for most IMGs may be due to many IMGs being older but also being more recent arrivals (i.e., less than 1 year in Canada).
- Given that IMGs from Eastern Europe, South Asia and Africa have had less success and half the likelihood of professional integration, these groups may need additional assistance in securing residency positions and/or redirection for improved labour market integration.
- Overall, the findings speak to the sample being a heterogeneous group of IMGs in the thick of the process of becoming professionally integrated.

6.3. Policy and program implications

Since the Access Centre is catering to a large population of international health professionals (over 10,000), including a majority of IMGs (over 8,300), it plays an important role vis-à-vis these highly skilled immigrants. A great proportion of IMGs who live in Ontario have made contact with the Access Centre –so it is an important point-of-contact with these people trying to figure out the complexities of the medical licensing system in Canada. Clearly this is a vulnerable group, given that many are unemployed, many have not taken the MCCEE exam, and so the Access Centre is working with a very needy clientele. It cannot be said how successful the Access Centre has been in helping IMGs secure employment, residency positions or educational/training opportunities (see discussion of limitations and recommendations for database revisions below), but what can be said is that this population of IMGs is a diverse group at various stages of the process for which they are in need of assistance. The Access Centre therefore is filling in a much-needed gap in the system of services for IMGs.

The findings also suggest that the Access Centre may want to consider tailoring some of its sessions and services to IMGs from South Asia, Eastern Europe and/or Africa in order to help these groups of IMGs since they appear to be having a harder time securing residency positions. It might also be useful to tailor some programs to IMGs who are having more trouble with a certain aspect of the licensing process.

The Access Centre could recognize that women, particularly young women, may be disadvantaged due to gender barriers and/or cultural expectations of childcare. Having the Access Centre consider the gender impact of their policies and programs may prove useful in this regard. If necessary, gender and cultural sensitivity training could be provided for staff.

The Access Centre, Ministry of Health and Long-Term Care and Immigration Canada could encourage IMGs who are outside of Canada to complete the MCCEE before entry. This would be in line with several stakeholder organizations. In general, more information could be provided to IMGs before they leave their countries of origin so that they are more familiar with the medical licensing process in Canada. They should be given information noting the challenges faced by IMGs already in the country that are trying to get integrated with mixed success. Given that a large number of IMGs outside of Ontario and Canada

contact the Access Centre, it gives the Access Centre a unique opportunity to encourage IMGs to take the right steps towards licensure before exiting their countries of origin.

Given that there is a huge untapped potential of IMGs living in Ontario, and that so many people do not have access to a family doctor, it may be useful for the Ministry of Health and Long-Term Care to re-look at dispensing more provisional licenses to IMGs who meet the criteria and are qualified to work under such temporary licenses. In the literature search, it was revealed that certain provinces are more open to provisional licensing than others and there are clearly different approaches taken by regulatory bodies. If the approach of having a larger number of provisionally licensed IMGs in Saskatchewan for instance is working, why not in Ontario? Another approach is deploying IMGs in other roles in the health care system such as Physician Assistants (PA); health human resource policies of task shifting are a possible solution to physician shortages in some areas. The pilot project in Ontario of the first civilian 2-year PA program at McMaster just recently finished in 2010. Lessons learned could be applied to helping better integrate IMGs in Ontario. The Ministry of Health and Long-Term Care could also look into providing more opportunities for bridge training and bridging programs that lead either to provisional or full licenses or into health sector-related careers for IMGs.

In developing services and programs for IMGs, the Access Centre has the opportunity to see that various groups of IMGs who register have more difficulty in finding employment and making it through the licensing process. The value of exploring characteristics of IMGs at registration is clear –it gives an overview of the big picture of who is coming to the centre and where they are. Besides improvements to the data collection, this information is very useful and meaningful in improving programs. Significant associations for employment status and for professional integration showcase that certain groups of IMGs may choose to not pursue full-time employment, either by choice or not, while others have lesser chances of getting into residency.

In sum, some policy and program implications could include:

- For the Access Centre:
    1. The Access Centre can recognize and help groups of IMGs such as from regions of origin having lesser chances of professional integration by tailoring sessions for them; for example, tailor some sessions to IMGs

from South Asia, Eastern Europe and/or Africa.

2. The Access Centre can recognize that women may be disadvantaged due to gender barriers by gender mainstreaming their programs and policies.
3. The Access Centre can encourage IMGs who are outside of Canada to complete the MCCEE before entry as well as provide more information to IMGs on the challenges and steps to integration in Canada.

- For the Ontario Ministry of Health and Long Term Care:
  1. The Ministry of Health and Immigration Canada can provide more to IMGs before they leave their countries of origin so that they are more familiar with the medical licensing process in Canada.
  2. The Ministry of Health could re-examine dispensing more provisional licenses, expanding physician assistant or bridge-training programs for IMGs who meet the criteria.

6.4. Limitations of the Thesis

The primary limitations of my thesis are: the quality and quality control of the data collected by the Access Centre, the various types of bias present, and the sample size limitations. First of all, in terms of quality, some variables were more incomplete than others, some variable categories were collapsed, and some variables needed to be excluded in further analyses. Baseline employment status also referred to unlicensed IMGs not working as an MD in Canada. Information on whether they were working clinically, teaching or conducting research was not available for this analysis. That information would have lent itself to more targeted questions. This study was also unable to answer questions on the well-being and needs of IMGs. Also, the findings from the study are useful and important to the Access Centre, but may not be generalizable the other populations.

Certain variables had very incomplete data, which has already been mentioned. It would have been particularly good if variables recording *sector of employment* or *NOC Code* and *occupation* were complete. In the development of the thesis proposal, questions relating to factors associated with working in the health sector or in various types of occupations could have been analyzed. These questions had to be discarded in favour of the questions on

employment status and professional integration outcomes. In the future such analyses could be used to compare with or add to findings by Boyd and Schellenberg (2007 and 2009), McDonald et al. (2009) and others [10, 12, 13].

What is important to mention here is also the way that *region of origin* and *region of education* variables categorized countries of the world that IMGs are from or where they studied medicine into specific regions. The categories were identical to those used by Boyd and Schellenberg (2007 and 2009) in her analysis of the 2001 Census data (10) (13). This approach was chosen since it has been used before and kept the number of categories fairly low, compared to using at least 100 countries as categories or a larger number of categories that McDonald et al. (2009) used [12]. One limitation was that the variable categories used here did not correspond exactly with categories used by McDonald et al. (2009) and grouped IMGs from very different countries into geopolitical regions of the world [12]. Another limitation of this approach was that Canadians that studied medicine abroad were not specifically identified, but grouped together with Americans, Western Europeans (and Australians and New Zealanders) into a single *region of origin* (North America, Western Europe) with their *region of education* indicating where they studied medicine in the world. A different approach would have kept a category solely for Canadians, albeit *country of origin* may be ambiguous given that many Canadians were naturalized and could put a *country of origin* as their *country of birth*. Of course the *citizenship status* variable would also help in identifying IMGs who were Canadian citizens, but who put down an alternate *country of origin* (which was then categorized into a *region of origin*).

It would have been useful if a greater amount of data were available on the pass rates of the *MCCEE, MCCQE1,* and *CE1* exams, as well as data on other exams such as the US medical licensing exams or the *MCCQE2*. This would have allowed even a descriptive comparison of pass rates amongst IMGs at the Access Centre compared to IMGs who took the MCC exams in 2006 [5]. Another thing that was lacking is that there was no variable recording English or French language test scores or a self-rated scale for language proficiency. This would have allowed for comparison with previous language testing results of IMGs from 2002 [20]. Of course these examination scores and tests are part of the resident selection process along with the interviews with selection being at the discretion of program directors. And, from a different angle, exam results are also considered to be structural

measures of quality of care of IMGs. With more robust and complete data, potentially a measure of the "strength" or "quality" of a candidate could have been added to the factors associated with securing a residency position (this measure would be a combination or weighing of various exam results, and/or language tests).

Secondly, different types of bias such as selection bias may be present. The source of bias may be in the inclusion criteria itself, such as exclusion of IMGs who were not living in Canada at the time of registration. Since information on the whereabouts of IMGs was not available beyond data recorded at registration, it is not known whether some of the IMGs that registered had moved to Ontario or Canada or not (during the study period). Selection bias may be also in the fact that IMGs who were users were solely selected for the professional integration outcomes question. This was due to a practical limitation of the data –only users were tracked from point of registration until securing a residency position, while non-users lost contact with the Access Centre shortly after registration and the follow-up time of 6 months or less. It is entirely plausible that many IMG non-users of the Access Centre were securing residency positions –but since that data was unavailable, then those IMGs had to be excluded from the analysis, thereby adding a source of bias. Finally, selection bias may also be present in the fact that all subjects in the study had at some point registered at the Access Centre – therefore these are IMGs who needed extra or more assistance than those who did not register.

Consequently, this group of IMGs may be the group that has been least successful in the residency matching process in Canada or the US and also this group may also be a group of IMGs less successful in finding full-time or part-time/casual employment (since the Access Centre also provides advice on alternate careers). This type of bias may also be termed *inclusive bias*, where the results of this study cannot be extrapolated to all IMGs in Canada or even Ontario –only IMGs who registered at the Access Centre.

Since this project was of interest to the researcher and continues to be a regular topic discussed in the media and journals, researcher bias is present and is here acknowledged. To lessen the effects of this bias, judgment and attaching a certain viewpoint to the interpretation of the results has been avoided as much as possible. Explanations have focused specifically on the results obtained and on their relation to similar studies conducted in the past. Advice and recommendations have specifically focused on the data collection & management

process, while avoiding political rhetoric, not appropriate for this thesis.

Since the majority of the data was self-reported, it was hard to increase the response rate on certain questions on the online registration form. Possibly shortening the form or making it simpler or easier for IMGs (such as through dropdown menus) to answer the questions in either English or French should be a priority. Rearranging items on the form could also do this as well. Also, what has already been noted is that better tracking of IMGs would be useful for the surveillance system. It can be said that procedural bias or an unfair amount of pressure on IMGs to fill out the online questionnaire, was not present in the data. This is because IMGs could complete the online form at any time from a computer with an Internet connection either from home, the library, or at the Access Centre's building in Toronto, Ontario. The Access Centre or researchers could consider conducting follow-up surveys and/or interviews to find out why many IMGs do not use the services beyond initial contact and to probe why so many are unemployed. Measurement bias has already been discussed especially with regards to the deficiencies of the data collection process and how it could be improved.

One bias, which was not well understood in the data, was differential response bias. There was missing data that had an impact on the fullness of the data analysis. In particular, during the professional integration outcomes survival model development phase, most variables were kept in the model, but a few variables had to be discarded, including: *first language spoken (is official language), baseline (or full-time) employment status, number of people in household, household income* and *time from graduation to registration*. This was because there was a differential amount of missing data per variable between those IMGs who became professional integrated and those who did not, which ranged from a 9% to a 39% difference. Since it was thought that such high differences in the amounts of missing data by the outcome would unduly affect the results, these variables were not kept in the analysis.

Finally, caution must be expressed in the interpretation of the descriptive proportions as well as odds ratios and hazard ratios. Odds ratios (ORs) under 1.45 for covariates in the baseline employment status logistic regression models are "undetectable" when sample size considerations are taken into account. Hazard ratios (HRs) under 1.4 for covariates in the professional integration outcomes model are also "undetectable", even if the association

exists. A larger sample size would have allowed for the detection of smaller ORs or HRs.

Increased odds of particular baseline employment statuses as well as increased hazard or risk professional integration must be understood to be an association, not necessarily predictive in the general sense of the word. The omission of certain variables due to missing data may have biased the results, and what can be said is that there are certain associations, stronger and weaker that have been detected. It is unknown what direction the results have been biased towards by the omission of certain variables from each model. But it was and is impossible to control for every factor (experimental error) that may be associated with employment status at baseline or securing a residency position.

6.5. Recommendations for the data collection & management process at the Access Centre

This section focuses on the data collection and management process of the Access Centre and to provide recommendations for improvements. There are numerous justifications for considering the Access Centre's administrative data system to be a sort of surveillance system. It could be termed a monitoring system or a means to see how the centre is performing, improve the data for analysis, and monitor their clients. The document, "Framework and Tools for Evaluating Health Surveillance Systems" [89] provides the following six steps used in this discussion: establishing the context of the surveillance system, developing evaluation questions, designing the process for data collection and management, collating and presenting the findings, reviewing an evaluation report, and following up on the use of findings.

6.5.1. Establishing the context of the surveillance system

The Access Centre's main role is to help internationally educated health professionals in their pathways to full licensure, or, if they choose, to alternate careers or training in Ontario. The success of their clients is in the best interests of the Access Centre, but having a means to see how their clients are doing, and to see how much they have been a help to them is important. Therefore, the purpose of this surveillance system or the purpose of ameliorating the already existing surveillance system is to collect and analyze data on their

clients and services offered in order to provide clients an improved experience, and be accountable to them and the people of Ontario.

The elements of the Access Centre's surveillance system involve both an online registration form for all clients to fill out in order to access and use the centre and post-registration updating of clients' files. Both the online registration form and the manner in which files are updated need to be improved. In a separate aspect of the evaluation, what would be helpful to include is a follow-up online form to fill out with questions on how satisfied clients are with the services at the Access Centre, for instance. One thing the Access Centre could easily implement is an automatic feedback to users when they have left a field empty – this would help with all of the missing data. Another question would be to ask what is the annual percentage of IMGs income spent on resources (in support of the licensing process), and if those costs are prohibitive. This would be useful to compare and contrast with Sharief and Zakus' (2006) finding that the costs borne by IMGs are very high [33].

The population under surveillance is the clients that come to seek the Access Centre's services and register through an online form after making contact with the centre either in person, by phone or online. The majority of clients at this time are IMGs. The information that is collected includes many variables, which use a confusing naming scheme, and some are unnecessary, while some essential ones are missing. The analysis and interpretation of data will allow for the clearer determination of clients success in their chosen career trajectories (for instance whether an IMG has secured a residency position, what kind of alternate job has he or she found, and when did they find it). Certain recommendations are also necessary in order to better inform the Access Centre on how to improve services for clients. It is important to note that clients' information must be kept confidential or anonymous when used for evaluation in order not to risk biasing the results of evaluations.

6.5.2. Developing evaluation questions

For this thesis, the purpose was to look at IMGs descriptively, but also approach more complex questions using logistic regression and survival analyses. It is impractical to expect such questions for evaluation to be addressed by the Access Centre's small staff, whose primary responsibilities are to provide client services. That is why evaluation questions need to follow the SMART framework: specific, measurable, actionable, relevant, and timely [89].

To facilitate the lives of future researchers, certain improvements to the surveillance system, which may not directly impact actionable evaluation items, should be made.

6.5.3. Designing the process for data collection and management

The data collected by the Access Centre exists in an internal database. The data were collected via an online registration form and by updating the data internally. Most data has been self-reported, but is collected nonetheless in this form of secondary data collection, which is administrative data, but could also be used for evaluation or research purposes. The data were collected continuously as new clients register to receive services from the Access Centre. Data collection via an online medium saves on paper costs and can be easily changed to include more or less questions. A discussion of the variables collected by the Access Centre follows.

Data on more than 53 variables are collected by the Access Centre but for this thesis only 53 were allowed to be disclosed, as additional variables contained confidential information such as the given name, surname and telephone number of clients. Eight of those variables were registration variables, including the status (with the centre) variable. This particular variable had to be recoded for the thesis, as the categories were unclear. It would be beneficial if this variable were recreated with renamed categories (an example is that instead of 'inactive – in-training', to have 'in residency training'). A small number of IMGs were labeled as 'inactive –alternative training', but there was no date attached to those IMGs having secured that alternative training or employment. The same was true of IMGs who secured a residency position – as the date of starting residency was not one of the variables in the database. The date or expected date of completion of residency, labeled as 'date of graduation of post-graduate education' was provided, and to obtain a residency start date, the country, school, program and other information was needed to backtrack and guess the residency start date. This process was not possible for those who found alternative training, as no additional information was provided, not even what kind of alternative training the IMGs were pursuing. That information would also be useful. In general, there has to be a better way to track those IMGs that use or have used the services of the Access Centre and the length of time they are in contact with the centre, in contrast to those IMGs that register at the centre, but decide not to use the services beyond initial point of contact.

Thirteen demographic variables are contained in the Access Centre's database. Certain categories of the *citizenship status* variable needed to be collapsed as a very small number of clients chose some of the original categories. There should be fewer categories, which are more informative. Instead of providing an age as a range from, say, 40-49 years, clients as of May 2009 need to include their birth date, which allows for more precise age determination. The same is true of *time in Canada* and *arrival date*. For this thesis, in order to use more of the data, the earlier *age* and *time in Canada* categories were used and variable categories collapsed, but for future analyses that will not include data pre-May 2009, researchers will be able to have continuous age and time in Canada variables. There are three language variables contained in the database, *first language spoken, languages spoken* and *preferred language of contact*. The first language spoken may be useful, but the Access Centre may want to consider using language spoken at home as well. The *languages spoken* variable was not necessary and could maybe not be used, as many IMGs did not answer this question – it also makes the questionnaire unnecessarily long. The *preferred language of contact* did not provide to be a useful variable either as most IMGs wanted to be served in English; however, instead of asking IMGs directly, the website should be available in both English and French, and if an IMG fills out the online form in English, then their preferred language would be English and vice versa. So this variable would be collected outside of the online form, making it shorter as well.

Six socioeconomic variables were included in the data collected by the Access Centre. Employment status was a very useful variable with four appropriate categories. Asking an IMG indicate their current *occupation* by typing it directly into the form causes problems for data collection as many IMGs misspell their occupation, or do not answer the question. A better way would be to create some kind of a drop down menu of the most common occupations and then have an 'other' category, if they cannot quickly locate their occupation. The same is true of sector of employment, where IMGs could simplify find and click on their sector. NOC Codes were obtained from the sector and occupation information provided. The household income and the number of people in household were useful in describing some of the demographic features of this population. Although more specific questions may or may not be included such as 'marital status' or 'number of children', since these questions may be important for future research in this demographic group and were

previously used by Szafran et al. (2005) in a survey of IMGs who competed in the 2nd iteration of the 2002 CaRMS match [87]. Another question to be asked would be 'visible minority status' which was recorded by McDonald et al. (2009) [12].

There were 26 educational/ training variables collected by the Access Centre. Application years for CaRMS and ERAS, whether they applied to residency, whether they obtained a residency interview, whether they took the MCCEE, MCCQE1, and CE1, the dates and scores on those tests were also useful. Since the NAC OSCE has now replaced the CE1, the Access Centre will need to update that variable. The last date of practice and the number of years experience variables are misleading. A single variable such as 'number of years working as a medical doctor' or 'last date working as a medical doctor' would be clearer. Some clarifications are required regarding the naming of variables; such as 'country of post-graduate education' could simply be 'country of residency training'. It would have been very good to use the medical specialty variable, but it was more than 70% incomplete, and could therefore not be used. Maybe this question could be asked upfront (on the first page of the questionnaire), with a drop down list of medical specialties and for an uncommon one, include an 'other' (please specify) type box. And since the date or expected date of completion of residency is recorded, why is the residency start date not recorded?

At this point, the Access Centre database contains a variable known as the status variable, which is updated post-registration for those that secure a residency position, find alternate careers or stop using the services of the centre. However, it would be more useful if there was a date attached to when an IMG notified the centre they would be starting a residency (that would be the last contact the centre has with the client) – instead of assuming the client was in touch with the centre an additional few months from last contact to starting residency. Also, when a client obtains alternative training or employment would also be useful, as that would also indicate the last contact with the centre. Finally, tracking the status of an IMG more precisely at the centre would also be helpful, in that it would allow for the determination of how long a user was actively using the services and when they decided to stop using the services. This would have avoided making the assumption that those users found to be 'inactive' at the study end date were never 'active' with the centre beyond initial contact (although this is overwhelmingly the case, nonetheless it would be helpful to be more precise here).

6.5.4. Collating and presenting the findings

One important aspect of a surveillance system is to gather the evidence, synthesize and interpret the results and present a summary of the findings [89]. Either the Access Centre or an outside person could summarize the findings from the surveillance system into a newsletter or briefing on progress and how things are going regarding certain indicators developed earlier.

It was suggested that it would be interesting to determine which factors are associated with an IMG choosing the medical licensing stream to choosing the alternative training or education (alternative careers stream). For users of the Access Centre services, the "primary stream" variable should be updated more precisely post-registration, in order for this analysis to be viable in the future.

6.5.5. Reviewing an evaluation report

After creating an evaluation report or newsletter, it is useful to review it. Although, in this case, as the Access Centre is not a massive entity and does not have many employees, these reports would be few, short and to the point. Depending on the audience, the information presented would need to be tailored. Another way of presenting the information would be to create a short PowerPoint presentation, video or pamphlet, showcasing and marketing the successes of the Access Centre, some of which is already done.

6.5.6. Following up on the use of findings

It would be important to follow-up regarding the findings of evaluation reports (or shorter documents) of the surveillance system. To ensure organizational capacity, it is important to have a proper allocation of resources, sound policy, good technical assistance, and visible audit reporting [89].

It would also be useful to follow-up with IMGs a few years down the road to see if they have successfully completed residency, alternative training, and if they have set up practice in Ontario or elsewhere, or what they are doing at that time, for instance, if they have given up on medicine. This may be a difficult exercise, but it would be helpful to gauge the success of IMGs in pursuing meaningful, and rewarding careers in medicine or related fields.

6.6. Future research implications

Further research could focus on the pass rates on various licensing exams (MCC etc.) of IMGs at the Access Centre. Other research could also look into the type of process used by the RCPSC in granting equivalence of residency training to IMGs who completed training in 29 jurisdictions around the world. Also, newly made available data from CAPER and CaRMS could potentially be linked, and could provide more answers to numerous unanswered questions about IMGs in Ontario as well as Canada. Finally, since this study used administrative self-reported data on a sizeable sample of IMGs in Ontario, it would be useful to conduct qualitative research such as interviews or focus groups with select IMGs at the Access Centre, which would be useful to compare the experiences of unlicensed IMGs with IMGs who managed to get through the process and become licensed in a Canadian jurisdiction.

Some of the most promising areas for future research are:

- Investigating the pass rates on licensing exams of IMGs at the Access Centre. These could be compared to general pass rate data provided by the MCC and would indeed be able to answer the question of whether this subset of IMGs is having more difficulty on exams than the whole population of IMGs taking the MCC exams.
- Conducting qualitative interviews or surveys with IMGs and staff at the Access Centre to probe further some of the current findings. These could include questions on:
    - The physical, mental and social well-being of IMGs
    - The needs of IMGs and what they expect from the Access Centre
    - Their experiences with the immigration system, the labour market, the medical licensing exams, and the regulatory authorities
    - Their rating of (or satisfaction with) the Access Centre's resources, advice and services
    - What IMGs specifically were doing before they came to Canada and where they would like to be in the next year, few years, 5 years
- Investigating the process of granting equivalence to IMGs who completed

residency training in 29 approved jurisdictions by the Royal College of Physicians and Surgeons of Canada.

- Linking data from the Canadian Post M.D. Education Registry (CAPER) and the Canadian Resident Matching Service (CaRMS), but also comparing the current and the CaRMS data to answer more questions on IMGs.
- Obtaining a copy of the 2011 Census data when it is released to ascertain the number and some characteristics of IMGs in Canada and Ontario.

6.7. Conclusions

The main messages from this study are that, first, the analyses reveal that the IMGs who are accessing services at the Access Centre are particularly vulnerable and as such, the Access Centre fills an important the gap that exists with regards to providing services to IMGs lost in the complexities of the system. It is essential for this service to be free and made known to as many IMGs as possible to help them become fully licensed doctors or transition to other careers. Indeed, provinces other than Ontario may want to explore setting up similar centres.

Second, the results confirmed some earlier findings, but differed in their focus on the more recent context in Ontario. IMGs registered at the centre came from all over the world and were at various stages of the process of career and/or professional integration. The data reflects less favourable labour market conditions as well as a minute portion of IMGs securing residency positions within the study period. Permanent residents who were more recent immigrants had smaller chances of being employed full-time. Since first language spoken was not significant, this finding may speak to good language proficiency of IMGs. Younger IMGs who have been in Canada less than five years and who have taken the MCCEE had the greatest chances of securing residency positions, whereas IMGs from Eastern Europe, South Asia and Africa have lesser chances of professional integration. In light of the findings, the Access Centre can recognize that some groups of IMGs may be particularly disadvantaged by their underlying characteristics vis-à-vis finding employment or securing residency positions. These groups can be targeted for specific interventions.

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APPENDICES

Appendix A - Description of services at the Access Centre

The Access Centre for Internationally Educated Health Professionals, located online and on-site in Toronto, Ontario, is a key component of Health Force Ontario (HFO), the health human resource multi-year plan for Ontario[49]. Unlicensed or unregistered IMGs in Ontario are directed to or find the HFO Access Centre online or in-person in order to obtain access to various free resources and services.

The Access Centre provides: comprehensive information about regulated health professions including:

- standards of professional qualifications and licensing and registration processes
- ongoing counseling and support
- contact information and referrals to the regulatory bodies
- alternative careers options
- on-site reference materials and resources, including an on-site library, referrals to relevant organizations and community resources
- links to education and assessment programs
- self-assessment tools
- information and referrals for retraining and bridge-training programs
- information sessions focused on various aspects of the registration process

[49] Source: HFO website: http://www.healthforceontario.ca

Appendix B - Description of IMG integration process

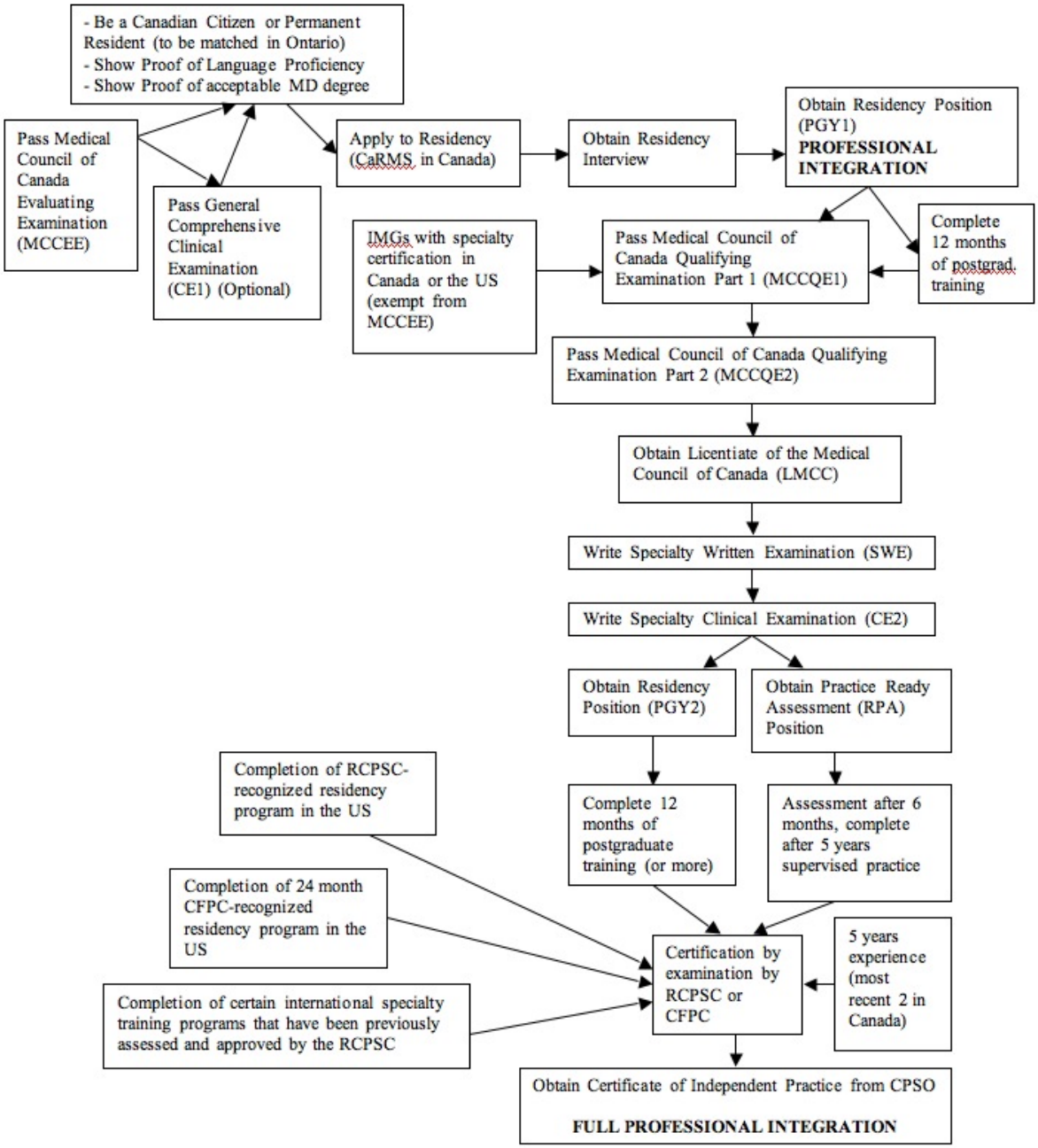
In order to for IMGs to immigrate and practice as physicians in Canada, they go through the following process [72]:

- First, IMGs enter Canada through: (1) the standard immigration process, (2) direct recruitment of IMGs done by provincial or regional authorities (not practiced in Ontario), or (3) by sponsorship through a Provincial Nominee Program (the first such pilot program in Ontario was begun in 2007).

- Next, IMGs go through the medical licensing process, which has six key steps:
  (i) Getting the MD degree approved by the Medical Council of Canada (MCC) by proving completion of an undergraduate MD degree at an approved university
  (ii) Passing standardized examinations (MCCEE, MCCQE1), demonstrating language proficiency in English of French (TOEFL/TSE/IELTS or DILF/DELF/DALF/TEF) and passing program-specific examinations to be eligible for provincial bridging or clinical assessment programs
  (iii) Finding a residency position by applying through the Canadian Resident Matching Service (CaRMS) or through programs specifically for IMGs (through the Centre for Evaluation of Health Professionals Educated Abroad (CEHPEA)
  (iv) Passing specialty examinations from the Royal College of Physicians and Surgeons of Canada (RCPSC) or the College of Family Physicians of Canada (CFPC) or by hiring needed specialists for urban hospital placements and fast-tracking the licensure of IMGs to meet the needs of underserved areas often through provisional licenses (very few granted in Ontario [41])
  (v) Passing MCCQE2 to obtain an independent license to practice medicine in Canada (known as the Licentiate of the Medical Council of Canada (LMCC), and finally
  (vi) Registration with a provincial regulatory body such as the College of Physicians and Surgeons of Ontario (CPSO).

Please see diagram of the integration process (*Flow Chart 1*) on the next page.

Flow Chart 1 - Process of integration to obtain full medical license in Ontario



Appendix C – List of variables contained in Access Centre database

1.	Entry	Entry number
2.	RegDate	Registration date (yyyy/mm/dd)
3.	PriStream	Client's primary: licensing or alternate careers
4.	SecStream	Client's secondary: licensing or alternate careers
5.	Prof	Profession – includes only medical graduates
6.	SecProf	Secondary profession
7.	TriProf	Tertiary profession/ comments for Access Centre staff
8.	Status	Client's status
9.	Citizen	Citizenship status
10.	City	City of residence
11.	Prov	Province of residence
12.	Country	Country of residence
13.	Aresid	Applied for residency position (yes/no)
14.	CaRMSYr	Application year(s) to CaRMS
15.	ERASYr	Application year(s) to ERAS
16.	ResInterv	Obtained a residency interview (yes/no)
17.	ResIntervYr	Year obtained a residency interview
18.	MCCEE	Wrote the MCCEE (yes/no)
19.	MCCEEDate	Date of writing the MCCEE
20.	MCCEEScore	Score on the MCCEE
21.	MCCQE1	Wrote the MCCQE1 (yes/no)
22.	MCCQE1Date	Date of writing the MCCQE1
23.	MCCQE1Score	Score on the MCCQE1
24.	CE1	Wrote the CE1 (yes/no)
25.	CE1Date	Date of writing the CE1
26.	CE1Score	Score on the CE1
27.	Gender	Gender includes men and women
28.	Birthdate	Date of birth (yyyy/mm/dd)
29.	AgeRange	Ranges in age such as "25-30 yrs."
30.	ArrivalDate	Arrival date in Canada (yyyy/mm/dd)
31.	TimeinCanada	Ranges in time such as "<1 year"
32.	LastDatePrac	Last date of practice (yyyy/mm/dd)
33.	ExpYears	Number of years of experience
34.	OriginCountry	Country of origin
35.	EduCountry	Country of (medical) education
36.	School	(Medical) school attended
37.	Program	Program at (medical) school attended
38.	GradDate	Date of graduation (yyyy/mm/dd) from medical school
39.	PostGradEduCountry	Country of post-graduate (medical) education
40.	PostGradSchool	School of post-graduate (medical) education
41.	PostGradProg	Program at school of post-graduate (medical) education
42.	PostGradDate	Date of graduation for post-graduate (medical) education
43.	FirstLang	First language spoken
44.	Langs	Languages spoken
45.	ContactLang	Language of contact (English or French)
46.	MedLang	Language of medical education
47.	Specialty	Medical specialty
48.	EmpStatus	Employment status
49.	Occupation	Occupation
50.	Sector	Sector of employment
51.	NOCCode	NOC Code for occupation
52.	Income	Household income
53.	People	Number of people in household

Appendix D – Definitions of variables in the dataset

Table A. Definitions of registration variables

#	Variable name	Definition
1	Account (entry number)	Client's account number
2	Registration date	Client's date of registration (mm/dd/yyyy)
3	Primary stream	Client's primary stream either licensing, education or employment
4	Secondary stream	Client's secondary stream either licensing, education or employment
5	Profession (medicine)	All clients who have a medical degree
6	Secondary profession	Client's secondary profession
7	Tertiary profession	Client's tertiary profession & comments for staff
8	Status (with the centre)	Client's status with the Access Centre

Table B. Definitions of demographic variables

#	Variable name	Definition
1	Citizenship status	Client's citizenship status (e.g. permanent resident)
2	City (of residence)	Client's mailing city (e.g. Marseille)
3	Province (of residence)	Client's mailing province (e.g. Bouches-du-Rhone)
4	Country (of residence)	Client's mailing country (e.g. France)
5	Gender	Client's gender
6	Birth date	Client's birth date (mm/dd/yyyy)
7	Age (range)	Client's age (e.g. 30-39 years old)
8	Arrival date	Client's arrival date in Canada (mm/dd/yyyy)
9	Time in Canada	Client's time in Canada (e.g. 1-3 years)
10	Country of origin	Client's country of origin (e.g. South Africa)
11	First language spoken	Client's first language spoken (e.g. Dutch)
12	Languages spoken	The languages the client speaks
13	Preferred language of contact	Client's preferred language of contact

Table C. Definitions of socioeconomic variables

#	Variable name	Definition
1	Employment status	Client's employment status (e.g. part-time)
2	Occupation	Client's occupation (e.g. community nurse)
3	Sector of employment	Client's sector of employment (e.g. health)
4	NOC Code	Client's National Occupational Classification code
5	Household income	Client's household income (e.g. $75,000+)
6	Number of people in household	The number of people in the client's household

Table D. Definitions of educational/training variables

#	Variable name	Definition
1	Applied for residency	Whether client applied for residency (e.g. yes/no)
2	CaRMS application year(s)	The year(s) the client applied in Canada
3	ERAS application year(s)	The year(s) the client applied in the US
4	Obtained residency interview	Whether client obtained an interview (e.g. yes/no)
5	Year(s) obtained residency interview	The year(s) the client obtained an interview
6	Took MCCEE	Whether client took the MCCEE (e.g. yes/no)
7	MCCEE date	The date the client took the MCCEE (mm/dd/yyyy)
8	MCCEE score	The score the client obtained on the MCCQE1
9	Took MCCQE1	Whether client took the MCCQE1 (e.g. yes/no)
10	MCCQE1 date	The date the client took the MCCQE1 (mm/dd/yyyy)
11	MCCQE1 score	The score the client obtained on the MCCQE1
12	Took CE1	Whether client took the CE1 (e.g. yes)
13	CE1 date	The date the client took the CE1 (mm/dd/yyyy)
14	CE1 score	The score the client obtained on the CE1
15	Last date of practice	Client's last date of practice (mm/dd/yyyy)
16	Number of years experience	Client's number of years of experience
17	Country of education	Country of medical education of client
18	School attended	Medical school attended by client
18	Program taken at school	Client's program taken at medical school
20	Graduation date	Client's graduation date from medical school (mm/dd/yyyy)
21	Country of post-graduate education	Client's country of residency (e.g. Canada)
22	School of post-graduate education	Client's school of residency (e.g. McMaster University)
23	Program of post-graduate education	Client's residency program name (e.g. family medicine)
24	Graduation date of post-graduate education	Client's date or anticipated date of graduation from a residency program (mm/dd/yyyy)
25	Language of medical education	The language the client studied medicine in
26	Medical specialty	Client's medical specialization (e.g. psychiatry)

Table E. Definitions of derived registration variables

#	Variable name	Definition
1	Time from registration to integration outcome	Time (in months) from client's registration until residency start date or study end date
2	Pending months	Time (in months) from client's registration until study end date for pending clients (prospective users)
3	Integration criteria	Selected all client's who meet inclusion criteria for professional integration model
4	User indicator	Indicates if client is a user or not (e.g. yes/no)
5	User type	Indicates the type of user the client is (e.g. current user)
6	Integration (in Canada/US)	Indicates if client has secured a residency position in the US or Canada (e.g. yes/no)
7	Study end date	The study end date (04/14/2011)

Table F. Definitions of derived demographic variables

#	Variable name	Definition
1	Citizenship status	Client's citizenship status; identical to original variable with the exception that clients on visitor visas have been merged with temporary resident clients
2	City type	Client's type of mailing city (e.g. town, small city, medium city, large city)
3	Urban status	Client's urban status (e.g. large city or not)
4	Age from birth date	Client's age (range) from birth date
5	Age	Client's age derived from age (range) and age from birth date variables
6	Time from arrival date	Client's time in Canada from arrival date (e.g. 4 years)
7	Time from entry	Client's time in Canada derived from Time from arrival date or Time in Canada variables
8	Region of origin	Client's region of origin derived from country of origin
9	First language spoken (is official language)	Client's first language spoken is official language of Canada (e.g. yes/no)

Table G. Definitions of derived socioeconomic variables

#	Variable name	Definition
1	Full-time employment status	Indicates whether client is in full-time employment or not (e.g. yes/no)
2	Household income	Client's household income; identical to original variable with those who did not answer included in the "prefer not to answer" category
3	Number of people in household	The number of people in client's household; identical to original variable with those who did not answer in a new category, "not answered"

Table H. Definitions of derived educational variables

#	Variable name	Definition
1	Program length (residency)	Client's approximate residency program length (years)
2	Residency start date	Client's approximate residency start date (mm/dd/yyyy)
3	Region of education	Client's region of education derived from country of education
4	Time from graduation until registration	The time from client's graduation from medical school until registration

Appendix E – Short description of literature search

Grey and published literature was identified, especially on IMGs in Canada over the past half-century. Grey literature was identified. Websites such as the College of Physicians and Surgeons of Ontario (CPSO) or the Canadian Resident Matching Service (CaRMS) were searched. Other searches were done using the Google search engine. Published literature was found by searching PubMed/Medline, Scholars Portal, and Google Scholar databases. Search terms included: international medical graduate, foreign medical graduate, graduate of a foreign medical school, immigrant doctor, foreign-trained doctor, overseas trained doctor, Canada, and the thirteen provinces and territories of Canada.

Appendix F – Dfbeta plots for the 'full-time vs. not full-time' status model

The assessment of the model was discussed in the section on baseline full-time employment status and included regression diagnostics. The dfbetas are the difference between the regression coefficient calculated for all of the data and the regression coefficient calculated with the observation deleted, scaled by the standard error calculated with the observation deleted. Dfbeta plots were an important tool in detecting outliers or influential observations.

The plot of dfbetas for the intercept, gender (male), age (Under 30 years) and age (40-49 years) are presented (*Figure A*). Dfbeta plots are unavailable for gender (female) or age (30-39 years) since those are the reference categories for the gender and age variables and therefore do not have regression coefficients associated therewith. It did not appear there were any outliers present in those plots as all points ranged between ±0.4 (*Figure A*).

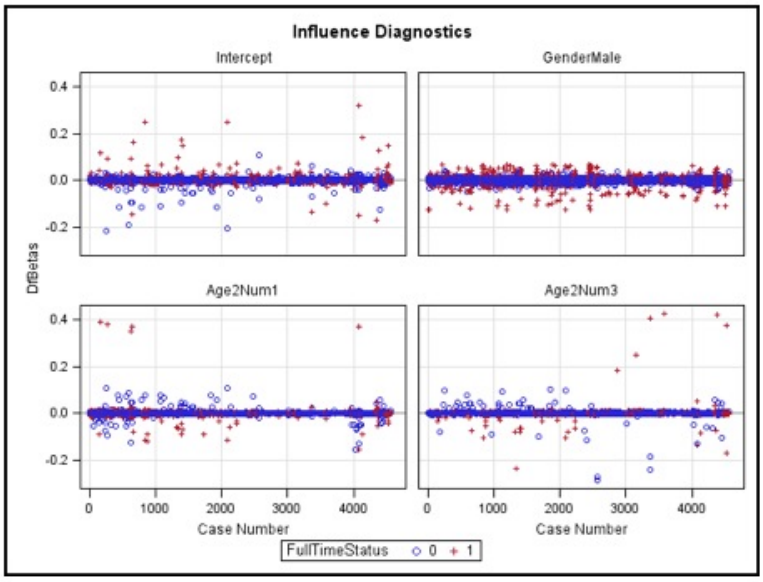


Figure A. Dfbeta plots for intercept, gender, and age I (N=4560)

The dfbeta plots for age (50 and over) and region of origin (West Asia; South Asia; Eastern Europe, respectively) are shown (*Figure B*). No outliers were present in those plots as all points range between ±0.4, with the exception of age (50 and over) graph that had one outlier (over 1.0) which was the same outlier detected earlier, namely observation number, 4354. This observation was removed.

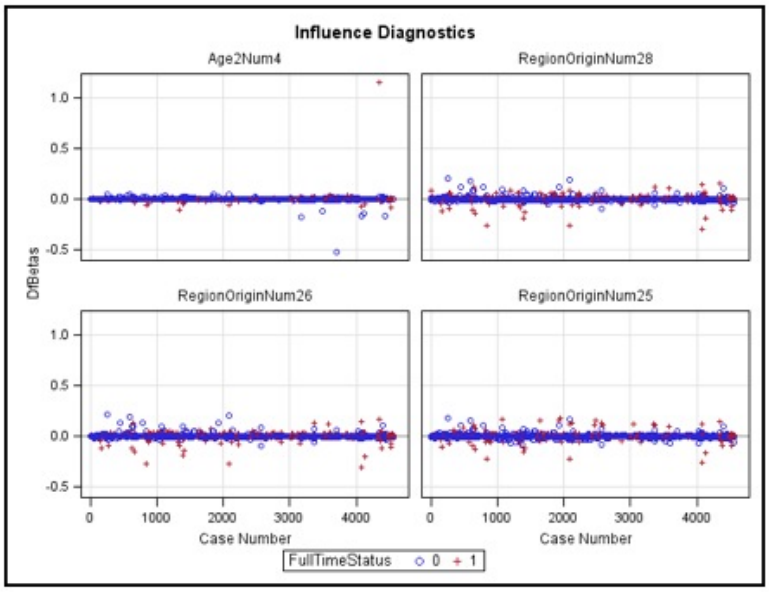


Figure B. Dfbeta plots for age and region of origin II (N=4560)

The dfbeta plots for region of origin (Africa; Southeast Asia; Caribbean, C/S America; East Asia, respectively) are shown (*Figure C*). It did not appear that there were any outliers present in those plots as all points' ranged between ±0.3.

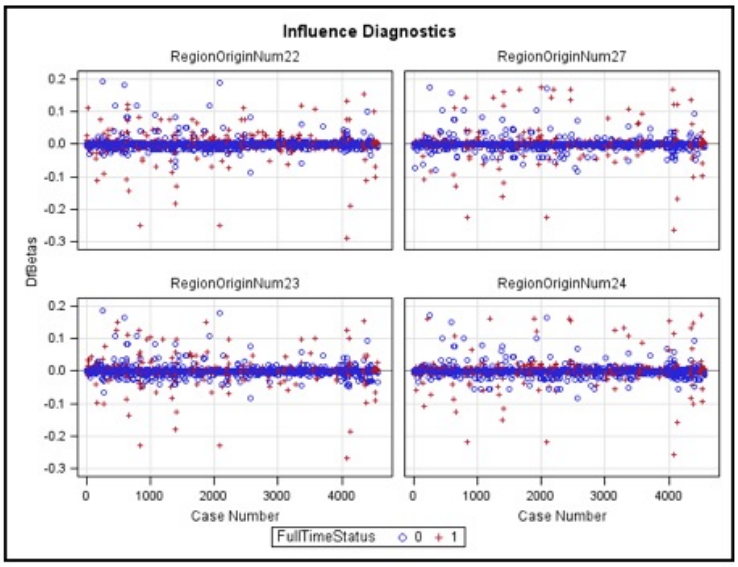


Figure C. Dfbeta plots for region of origin III (N=4560)

The dfbeta plots for citizenship status (permanent resident; temporary resident; and other, respectively) and first language spoken (is official language) (Not answered) are shown (*Figure D*). It did not appear that there were any outliers present in those plots as all points' ranged between ±0.2.

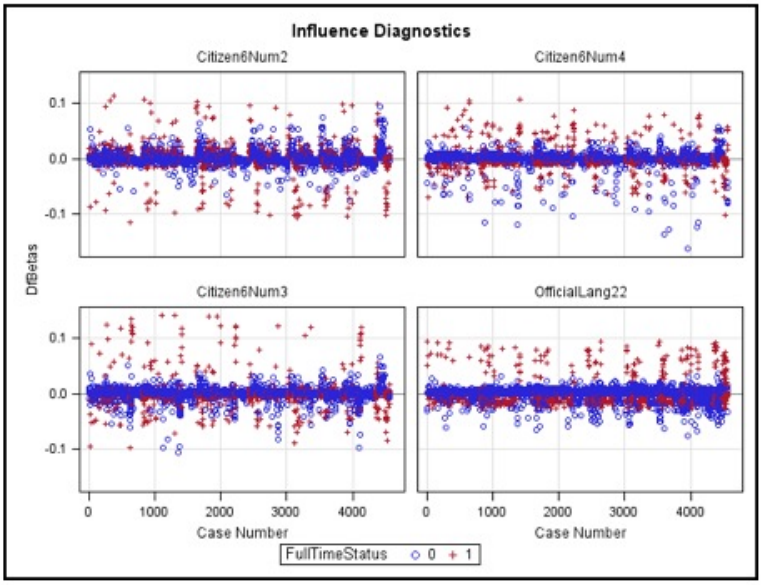


Figure D. Dfbeta plots for citizenship status and first language spoken (is official language) IV (N=4560)

Figure E showed the dfbeta plots for first language spoken (is official language) (Yes vs. No) and time from entry (5-10 years, 1-5 years, and Over 10 years vs. less than 1 year, respectively). There did not appear to be any outliers as all points' ranged between ±0.4, with the exception of the time from entry (1-5 years) graph where there were two points outside of that range (over 0.4), namely observation numbers, 1338 and 4516.

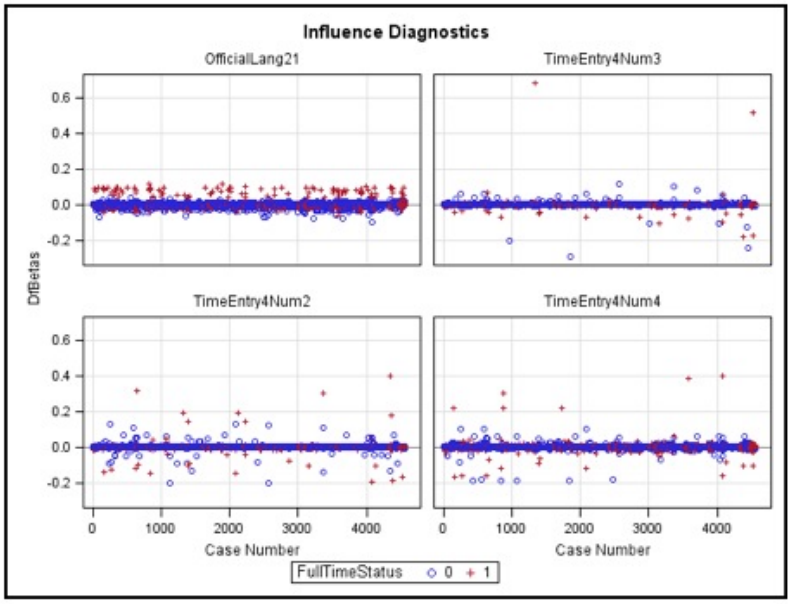


Figure E. Dfbeta plots for first language spoken (is official language) and time from entry V (N=4560)

The dfbeta plots for the interactions: gender and age and gender and time from entry are shown (*Figures F & G*). There did not appear to be any outliers as all points' ranged between ±0.4.

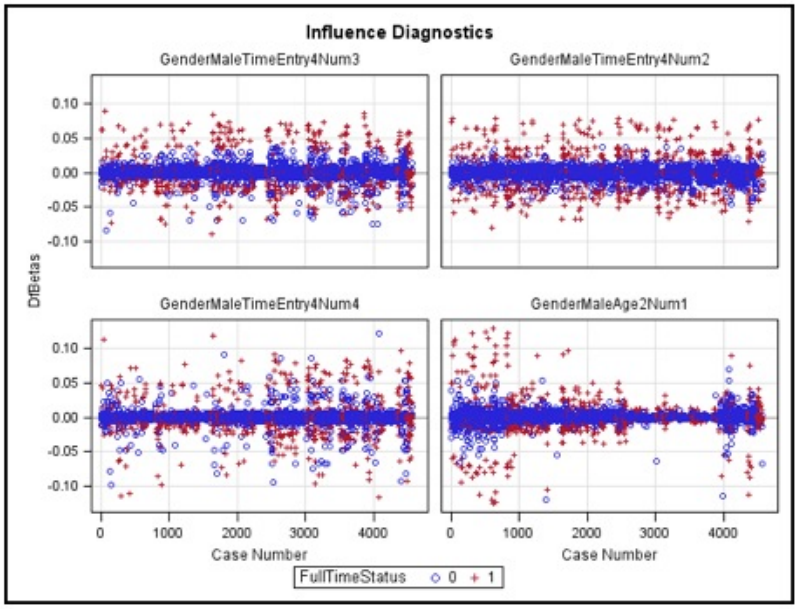


Figure F. Dfbeta plots for the interaction of gender and time from entry VI (N=4560)

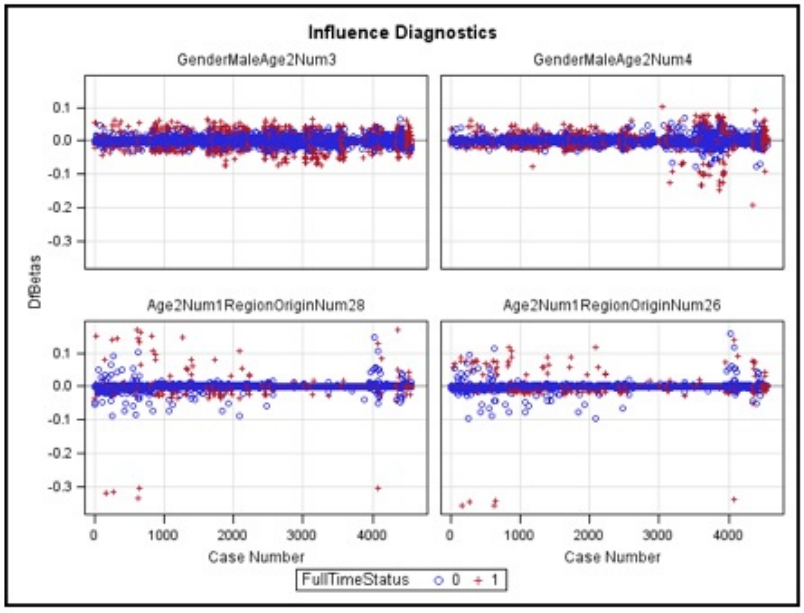


Figure G. Dfbeta plots for the interactions of gender and time from entry; age and region of origin VII (N=4560)

The two lower plots in *Figure H* as well as plots in Figures *I-L* showed the dfbeta plots of the interaction of age and region of origin categories. All graphs range was ±0.4 with no outliers, with the exception of *Figures K-L*, which did show outliers.

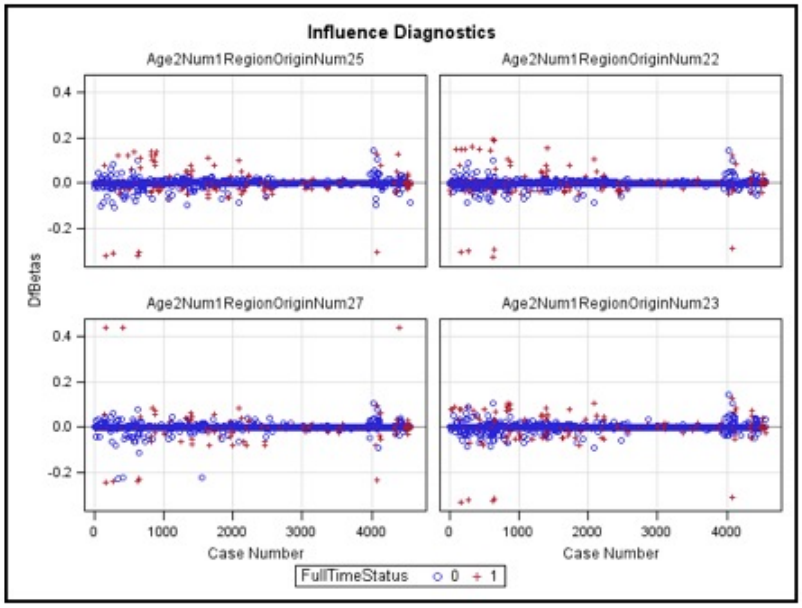


Figure H. Dfbeta plots for the interaction of age and region of origin VIII (N=4560)

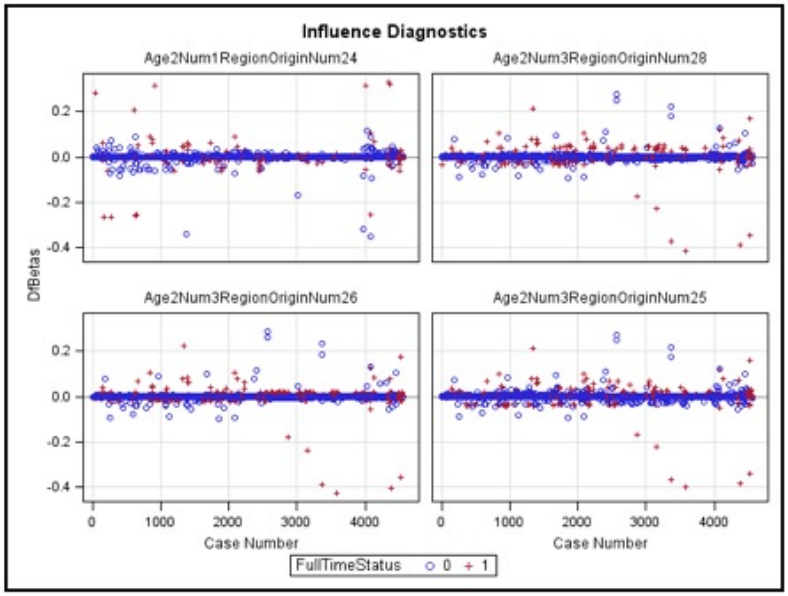


Figure I. Dfbeta plots for the interaction of age and region of origin IX (N=4560)

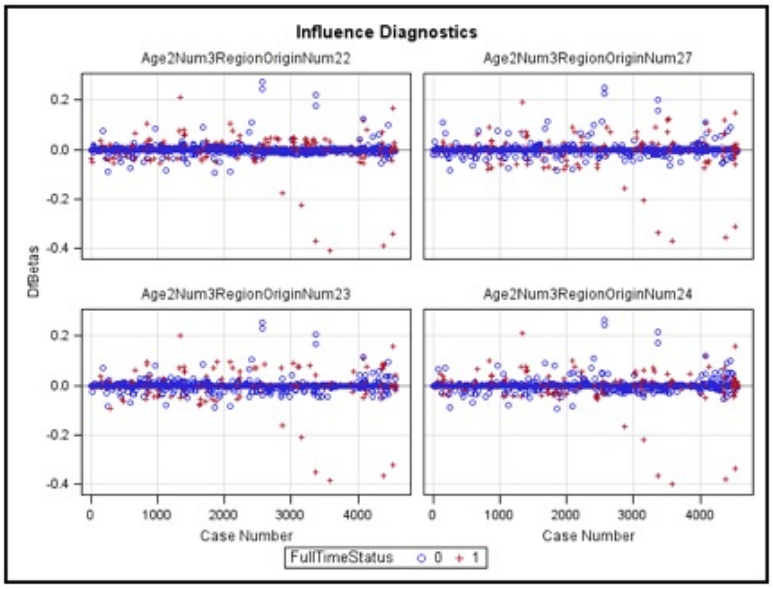


Figure J. Dfbeta plots for the interaction of age and region of origin X (N=4560)

Figure K showed outliers (above 0.4 or below -0.1) at the following observation numbers, 3709 and 4354. Otherwise the range of observations was ±0.4.

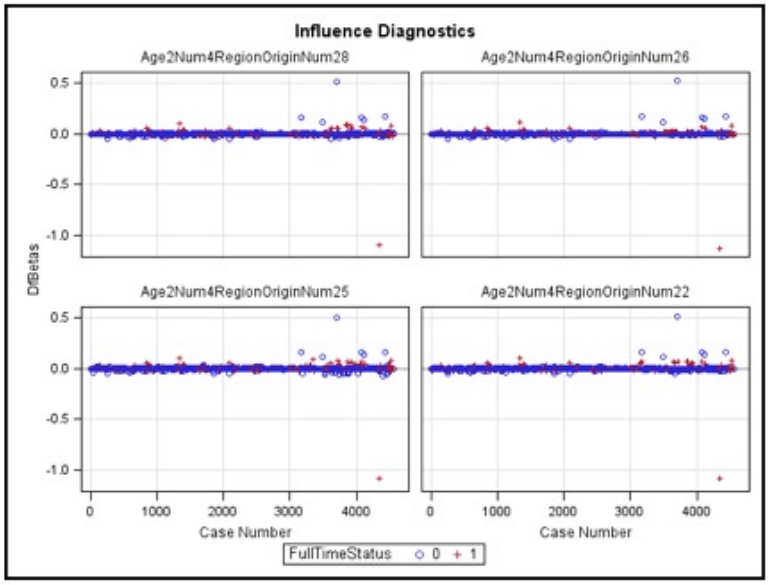


Figure K. Dfbeta plots for the interaction of age and region of origin XI (N=4560)

Figure L showed evidence of outliers at values above 0.4 and below -0.5. The upper two graphs show outliers at observation numbers, 3709 and 4354. The bottom two graphs showed the dfbeta plots for the interaction of age and region of origin. Outliers present were at observation numbers, 1338 and 4516.

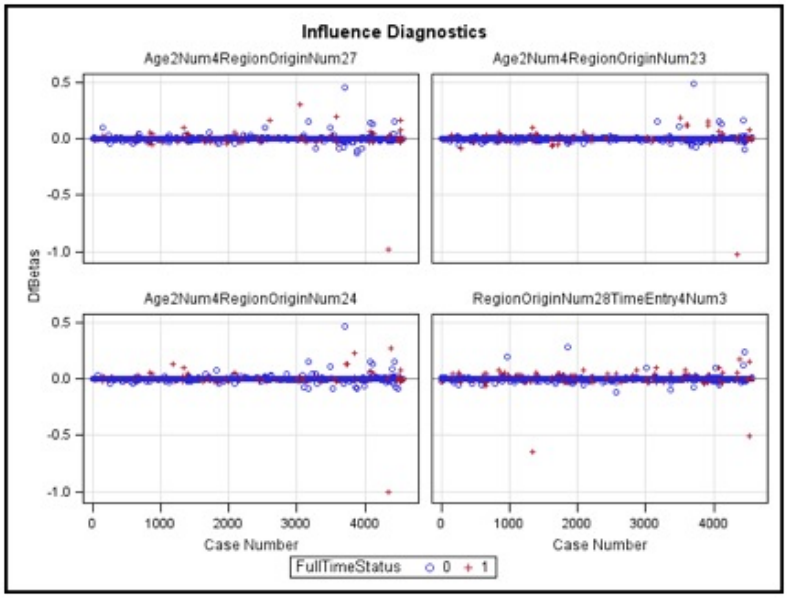


Figure L. Dfbeta plots for the interactions of age and region of origin; region of origin and time from entry XII (N=4560)

The next set of dfbeta plots in *Figures M-Q* all showed the same outliers at observation numbers, 1338 and 4516. *Figures M-Q* were all showing the various categories of region of origin interacting with time from entry. The outliers were investigated and removed if they caused undue influence on the model.

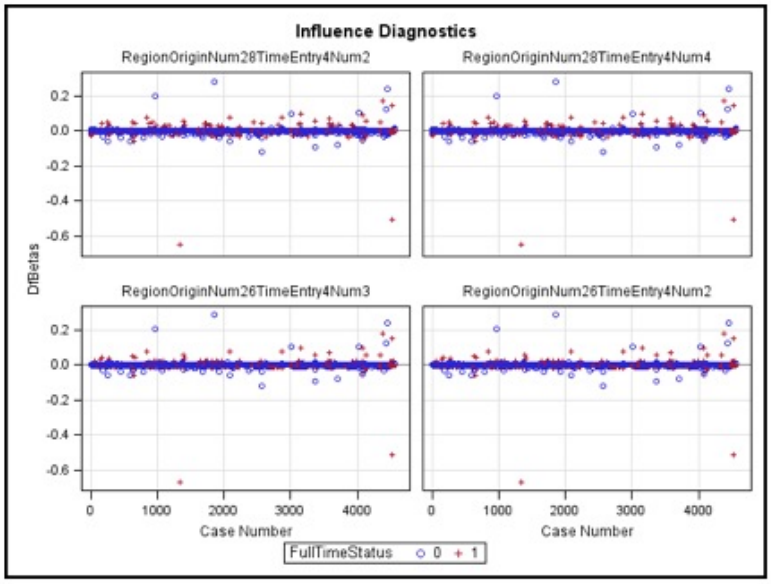


Figure M. Dfbeta plots for the interaction of region of origin and time from entry XIII (N=4560)

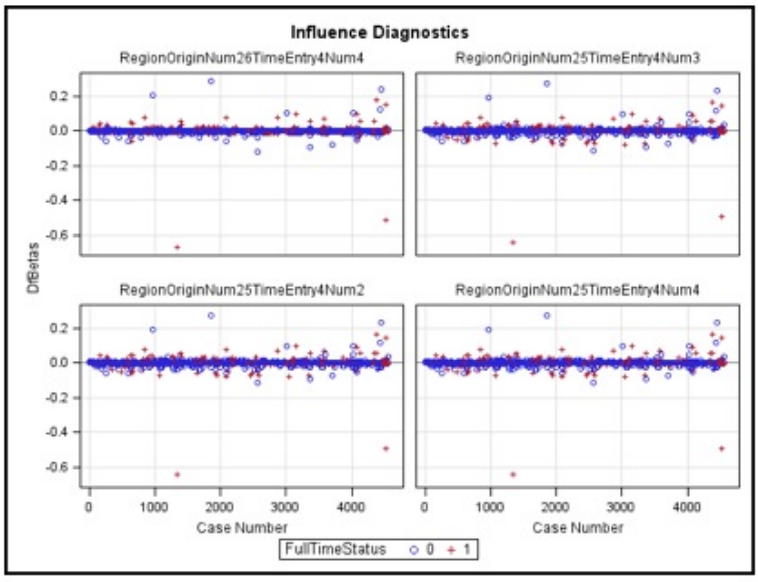


Figure N. Dfbeta plots for the interaction of region of origin and time from entry XIV (N=4560)

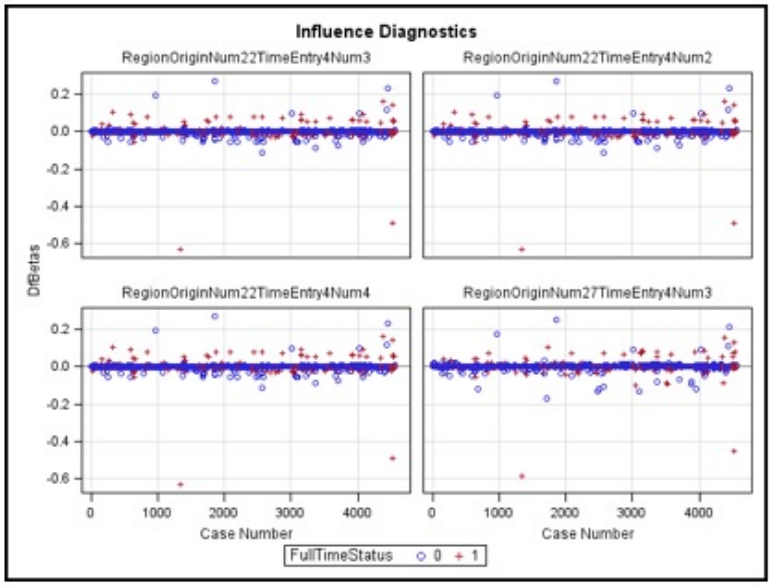


Figure O. Dfbeta plots for the interaction of region of origin and time from entry XV (N=4560)

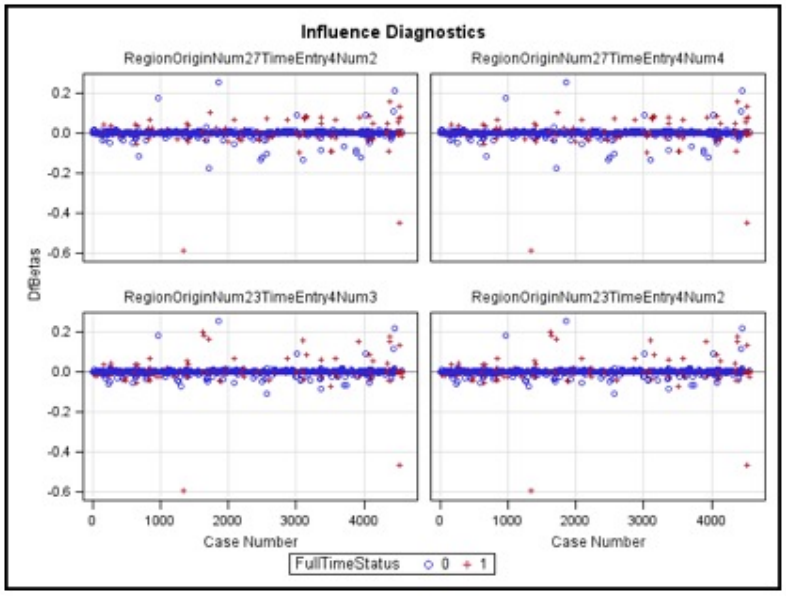


Figure P. Dfbeta plots for the interaction of region of origin and time from entry XVI (N=4560)

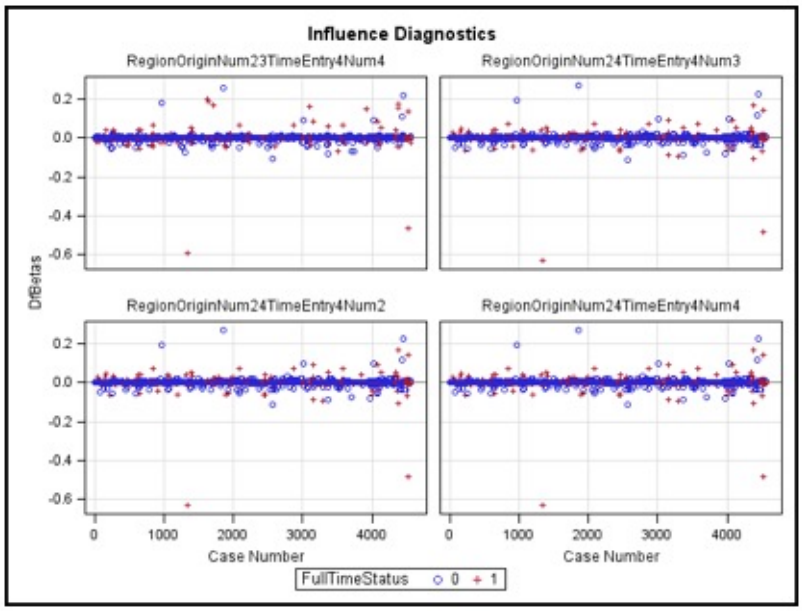


Figure Q. Dfbeta plots for the interaction of region of origin and time from entry XVII (N=4560)

Appendix G - Dfbeta plots for the 'full-time vs. not employed' model

The dfbeta plots for the intercept, gender (men), and age (under 30 years and 40-49 years, respectively) is shown (*Figure E1*). It did not appear there were any outliers present in those plots as all points ranged between ±0.3.

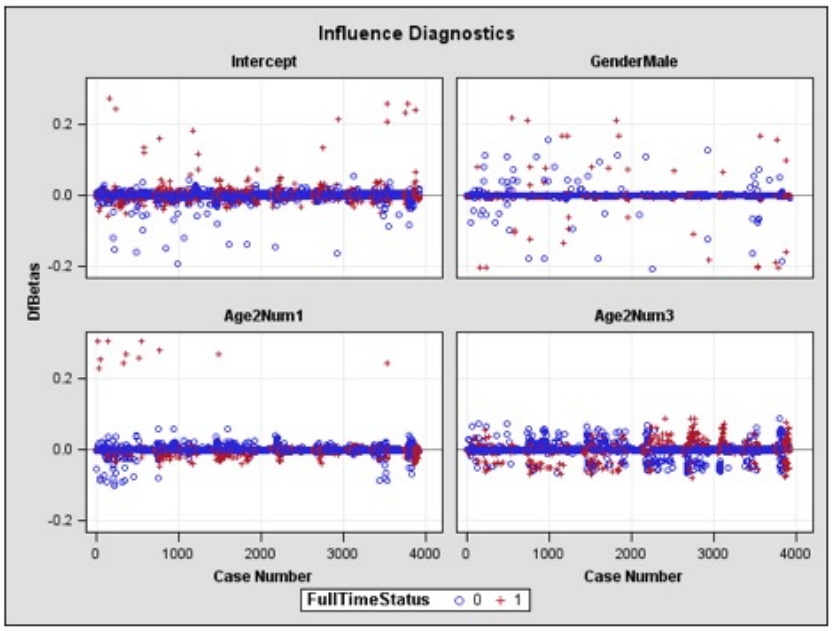


Figure E1. Dfbeta plots for intercept, gender, and age I (N=3260)

The dfbeta plots for age (50 and over) and region of origin (West Asia; South Asia; Eastern Europe, respectively) are shown (*Figure E2*). No outliers were present in those plots as all points range between ±0.3.

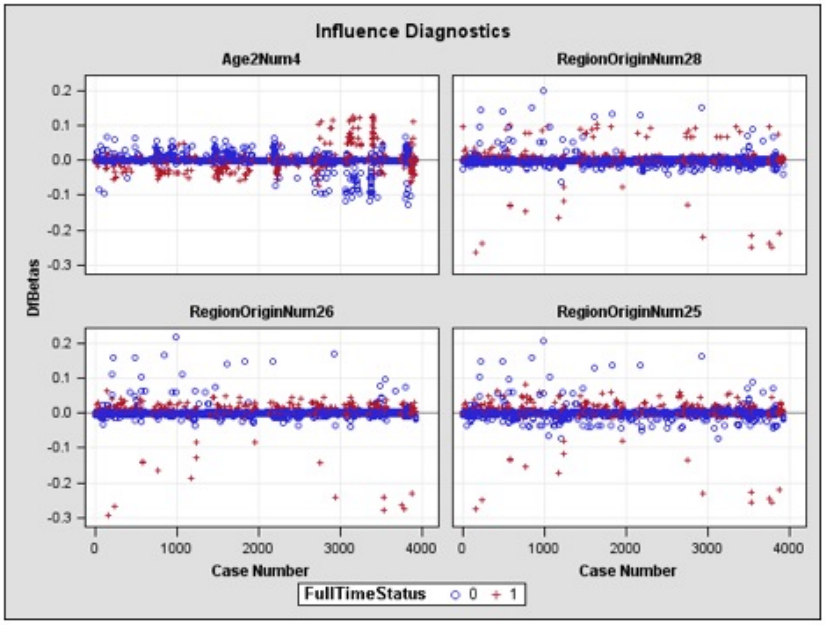


Figure E2. Dfbeta plots for age and region of origin II (N=3260)

The dfbeta plots for region of origin (Africa; Southeast Asia; Caribbean, C/S America; East Asia, respectively) are shown (Figure 3). It did not appear that there were any outliers present in those plots as all points' ranged between ±0.3.

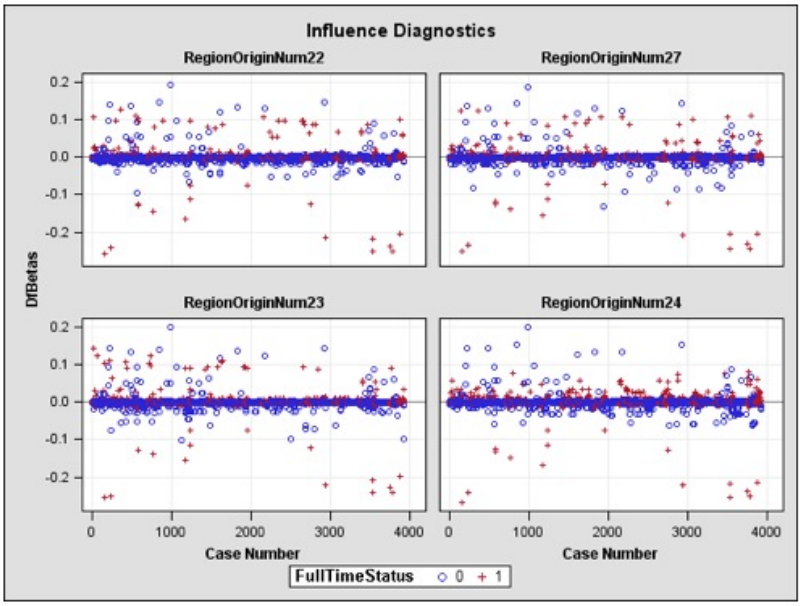


Figure E3. Dfbeta plots for region of origin III (N=3260)

The dfbeta plots for citizenship status (permanent resident; temporary resident; and other, respectively) and first language spoken (is official language) (Not answered) are shown (*Figure E4*). It did not appear that there were any outliers present in those plots as all points' ranged between ±0.2.

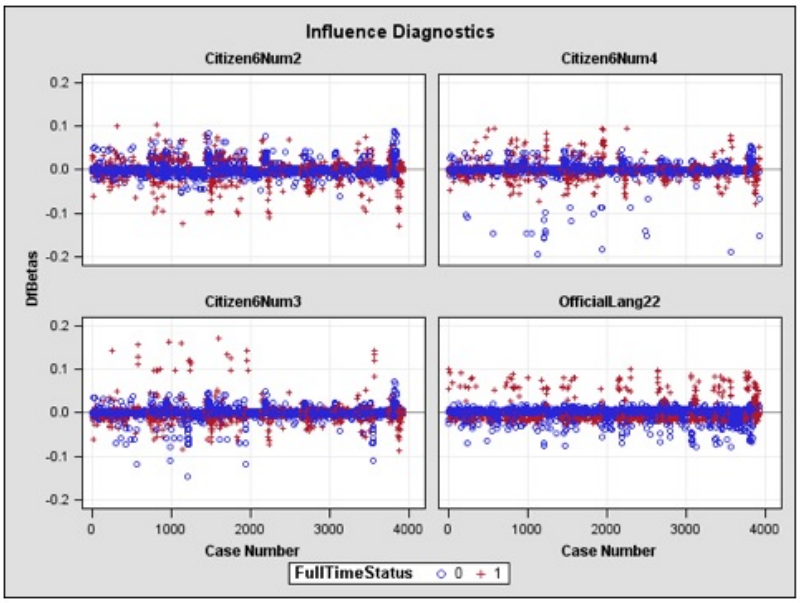


Figure E4. Dfbeta plots for region of citizenship status and first language spoken (is official language) IV (N=3260)

The dfbeta plots for first language spoken (is official language) (Yes) and time from entry (5-10 years, 1-5 years, and Over 10 years, respectively) are shown (*Figure E5*). Points' ranged between ±0.2, with no outliers.

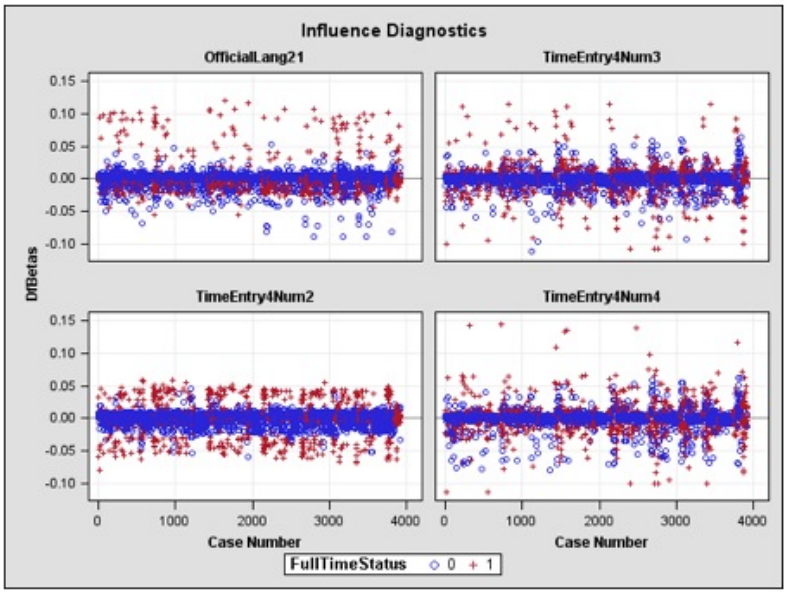


Figure E5. Dfbeta plots for first language spoken (is official language) and time from entry V (N=3260)

Figures E6, E7 and *E8* showed the dfbeta plots for the interaction: age and citizenship status. There appeared to be one outlier with values over 1.0. This was confirmed as the outlier previously identified using influence diagnostics, which was observation number 3260.

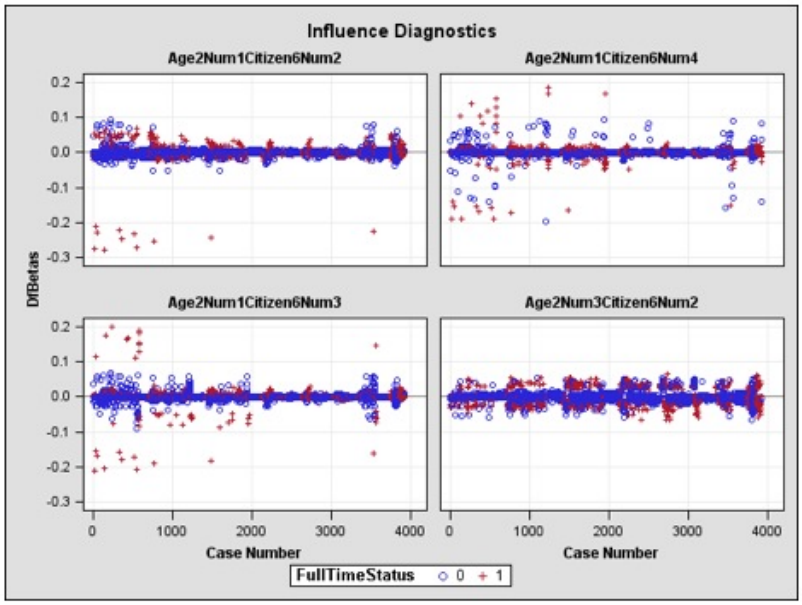


Figure E6. Dfbeta plots for the interaction of age and citizenship status VI (N=3260)

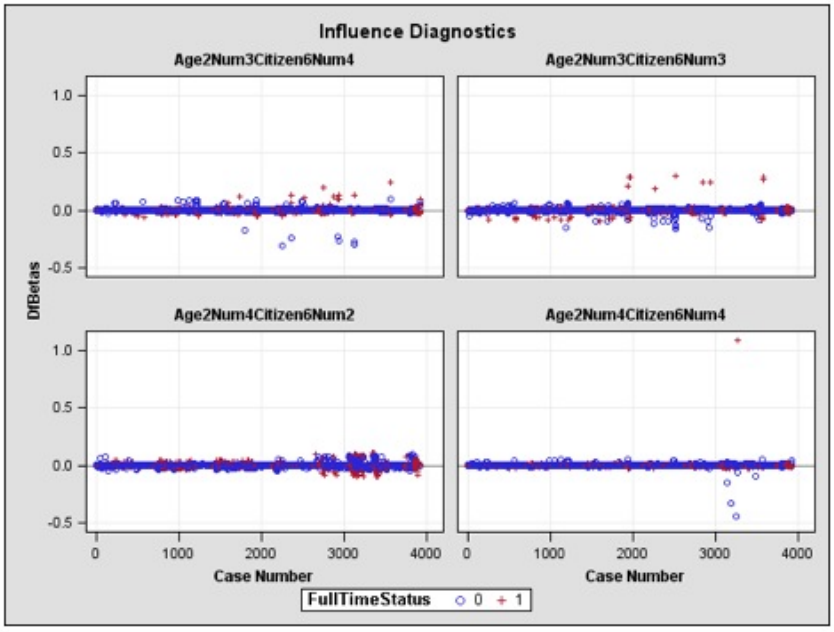


Figure E7. Dfbeta plots for the interaction of age and citizenship status VII (N=3260)

Figures E8 and *E9* showed the dfbeta plots for the interaction: gender and region of origin. There did not appear to be any outliers as all points' ranged between ±0.2.

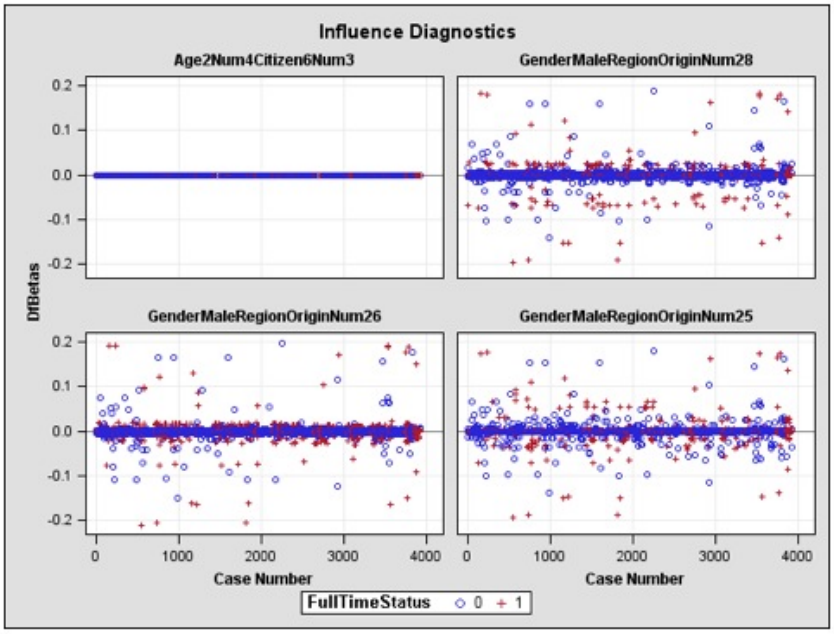


Figure E8. Dfbeta plots for the interactions of age and citizenship status; gender and region

of origin VIII (N=3260)

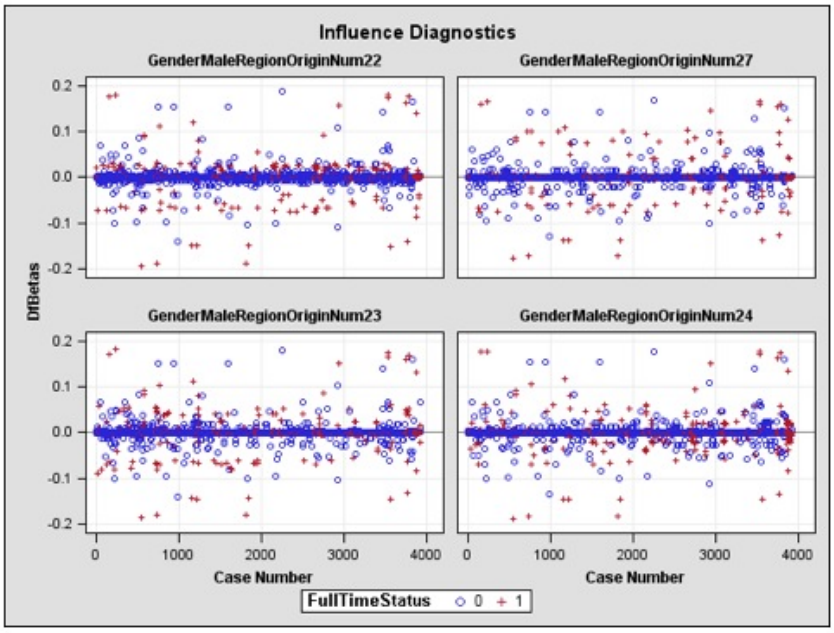


Figure E9. Dfbeta plots for the interaction of gender and region of origin IX (N=3260)

Appendix H - Dfbeta plots for the 'part-time/casual vs. not employed' model

Figure F1 showed the dfbeta plots for the intercept, gender (men), and age (under 30 vs. 30-39 and 40-49, respectively). It did not appear there were any outliers present in those plots as all points ranged between ±0.3.

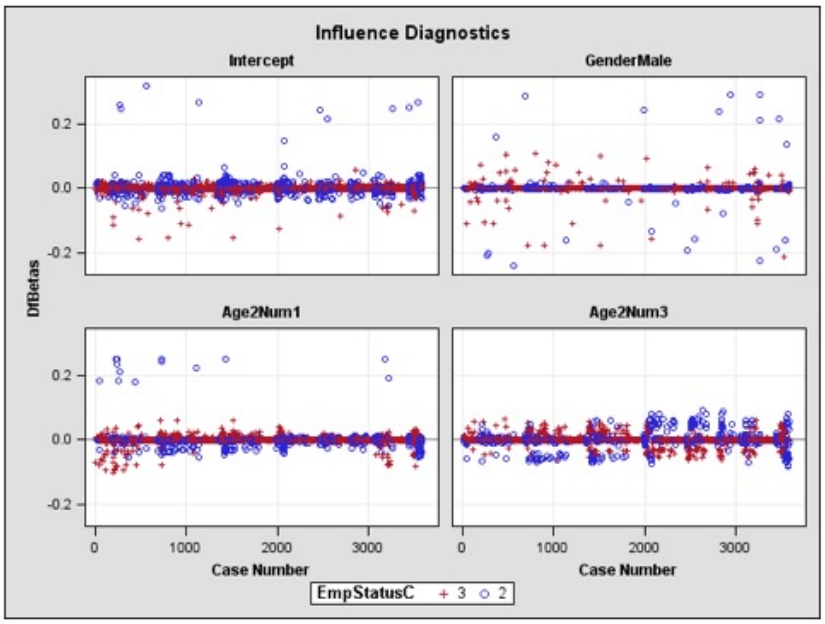


Figure F1. Dfbeta plots for intercept, gender, and age I (N=3260)

Figure F2 showed the dfbeta plots for age (50 and over vs. 30-39) and region of origin (West Asia; South Asia; Eastern Europe vs. North America, Western Europe, respectively). No outliers were present in those plots as all points range between ±0.3.

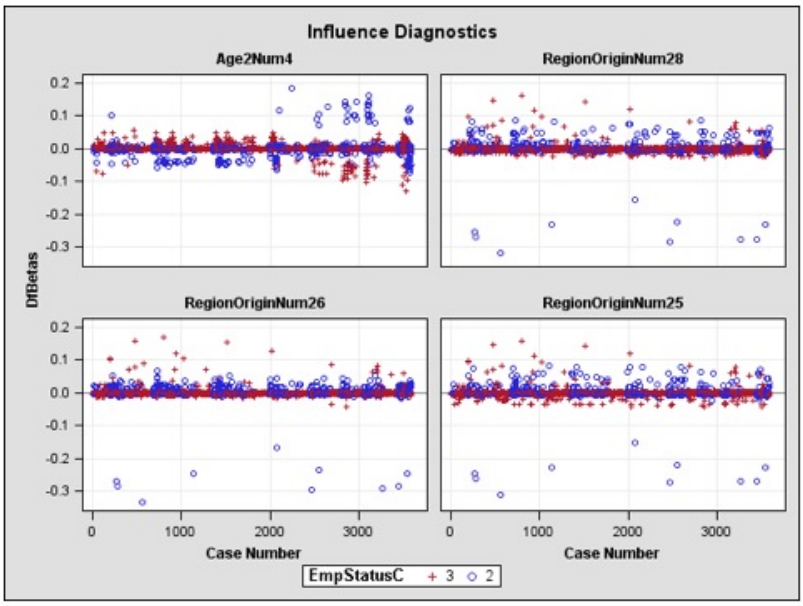


Figure F2. Dfbeta plots for age and region of origin II (N=3588)

Figure F3 showed the dfbeta plots for region of origin (Africa; Southeast Asia; Caribbean, C/S America; East Asia, respectively). It did not appear that there were any outliers present in those plots as all points' ranged between ±0.3.

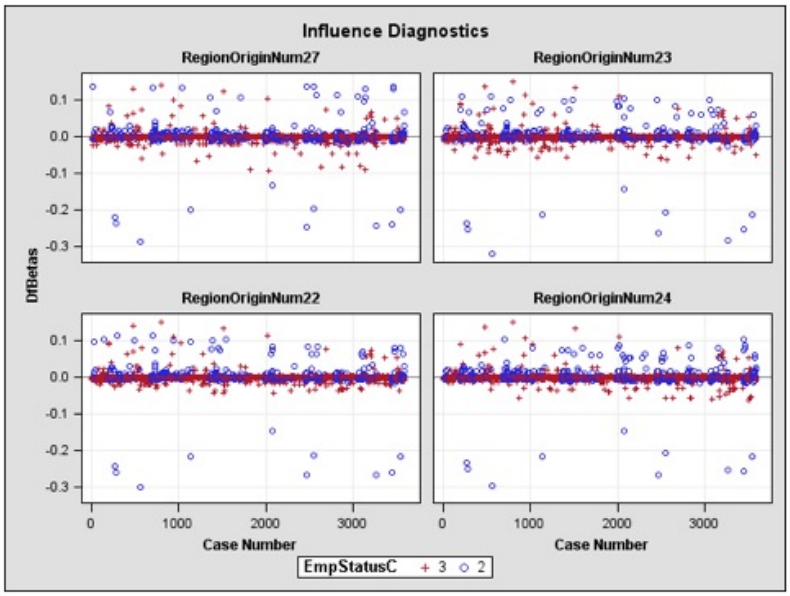


Figure F3. Dfbeta plots for region of origin III (N=3588)

Figure F4 showed the dfbeta plots for citizenship status (permanent resident; temporary resident; and other, respectively) and first language spoken (is official language) (Not answered). All points' ranged between ±0.4, with no outliers.

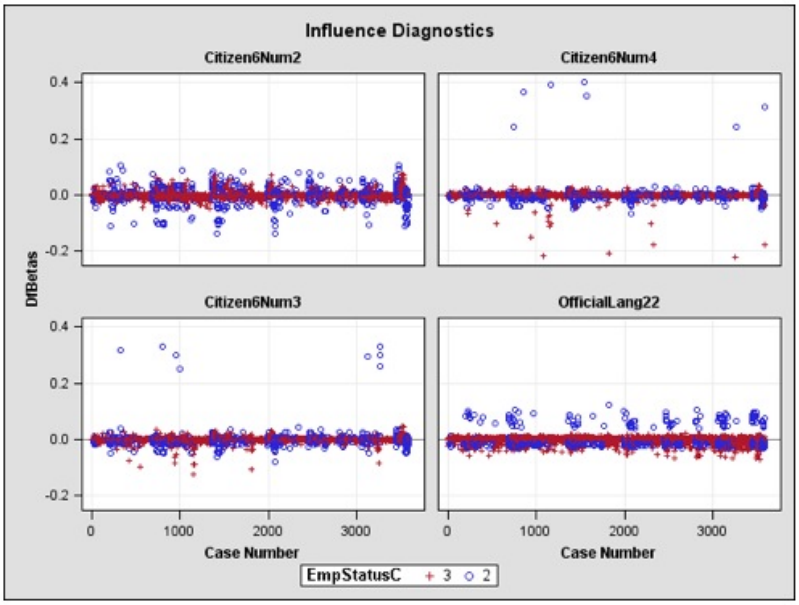


Figure F4. Dfbeta plots for region of citizenship status and first language spoken (is official language) IV (N=3588)

Figure F5 showed the dfbeta plots for first language spoken (is official language) (Yes) and time from entry (5-10 years, 1-5 years, and Over 10 years, respectively). There did not appear to be any outliers as all points' ranged between ±0.2.

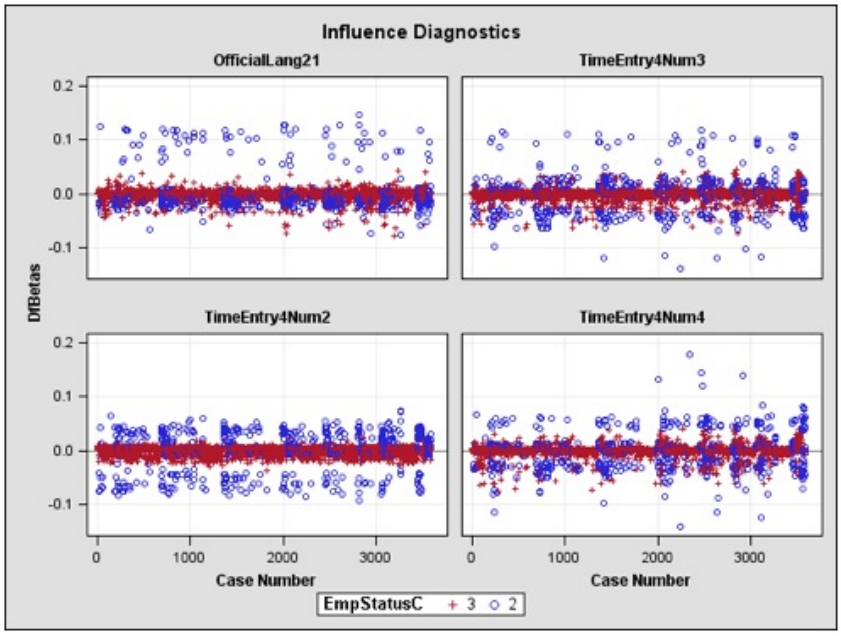


Figure F5. Dfbeta plots for first language spoken (is official language) and time from entry V (N=3588)

Figures F6, F7 and *F8* showed the dfbeta plots for the interaction: age and citizenship status. There appeared to be two outliers with values above 0.4 in the Age2Num1Citizen6Num4 plot (interaction of age and citizenship status at age= under 30, citizenship status= other/not answered). There also appeared to be two outliers with values above 0.5 in the Age2Num3Citizen6Num3 plot (interaction of age and citizenship status at age=40-49, citizenship status=temporary resident). There also appeared to be one outlier with a value above 1.0 in the Age2Num4Citizen6Num4 plot (interaction of age and citizenship status at age=50 and over, citizenship status=other/not answered). Finally, another two outliers were found with values above 0.4 in the Age2Num4Citien6Num3 plot (interaction of age and citizenship status at age=50 and over, citizenship status=temporary resident).

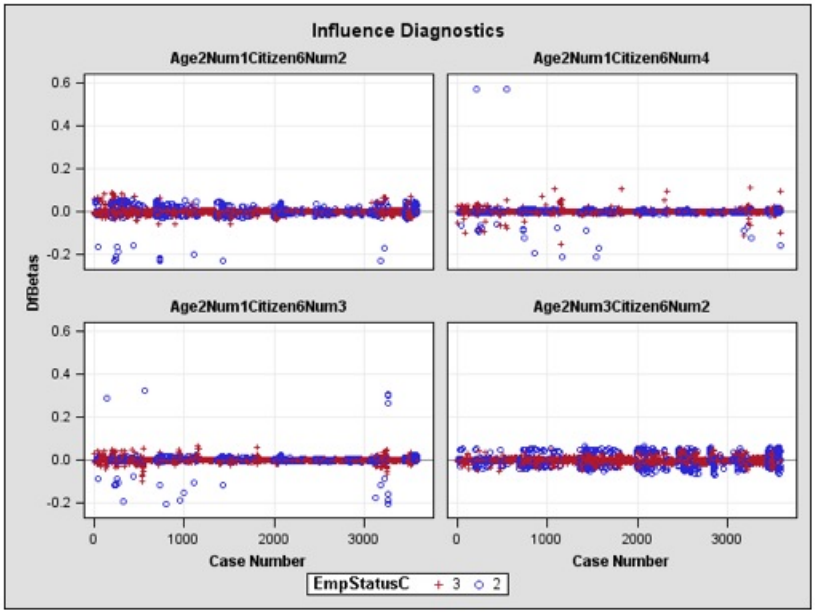


Figure F6. Dfbeta plots for the interaction of age and citizenship status VI (N=3588)

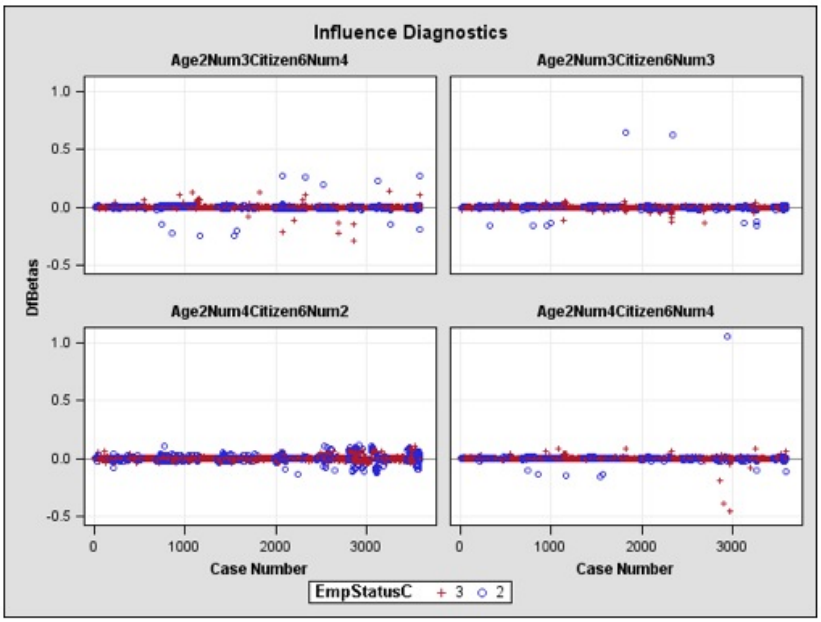


Figure F7. Dfbeta plots for the interaction of age and citizenship status VII (N=3588)

Figures F8 and *F9* showed the dfbeta plots for the interaction: gender and region of origin. There did not appear to be any outliers as all points' ranged between ±0.3.

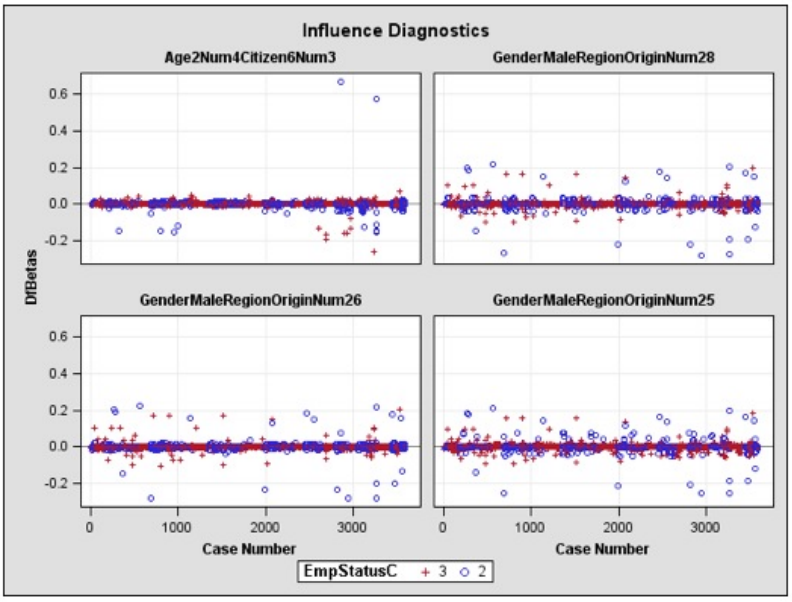


Figure F8. Dfbeta plots for the interactions of age and citizenship status; gender and region of origin VIII (N=3588)

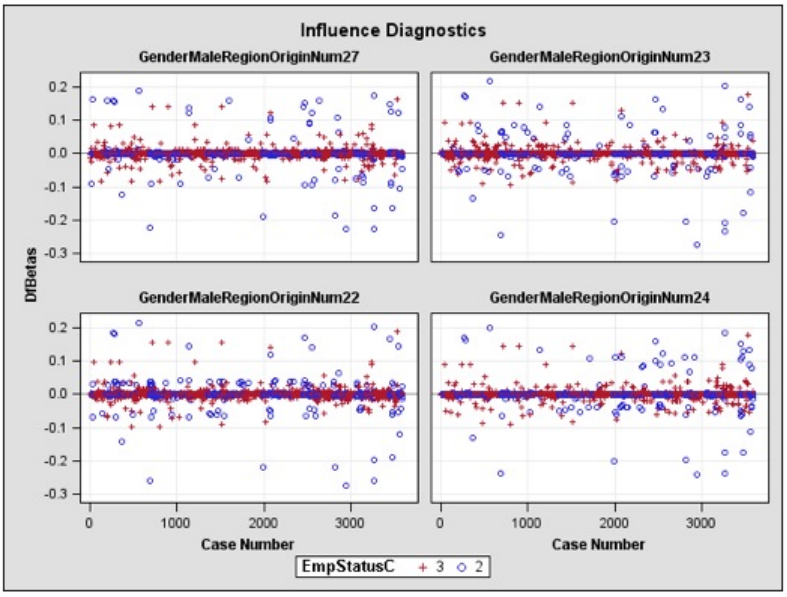


Figure F9. Dfbeta plots for the interaction of gender and region of origin IX (N=3588)

Appendix I – Deviance and Schoenfeld residuals for survival analysis model

Deviance residuals are negative for observations, which have a longer survival time than expected and positive for observations that have a shorter survival time than expected. None of the deviance residual plots vs. a particular variable shows deviations much beyond ±3 (*Figures G1-G6*).

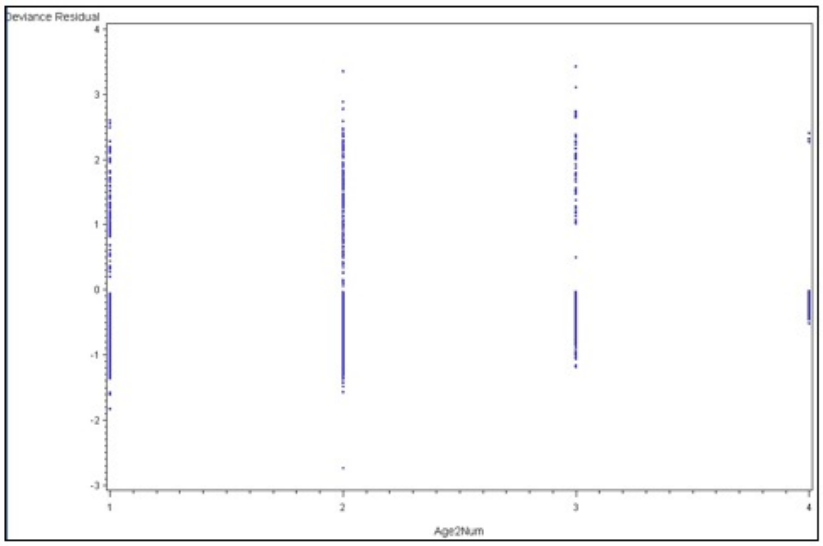


Figure G1. Deviance residuals for age (N=2413)

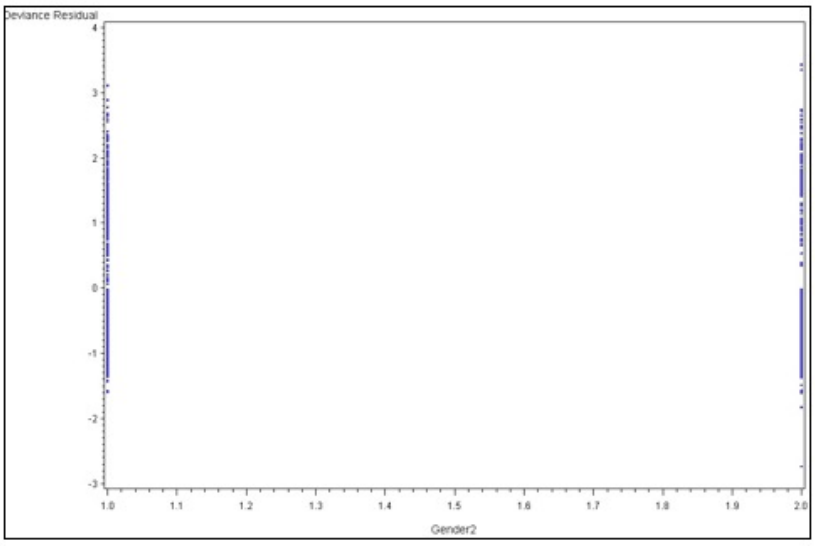


Figure G2. Deviance residuals for gender (N=2413)

In both of the above graphs, there may be some points that lie above 3 on the scale, but since they are close to 3, they do not pose a problem.

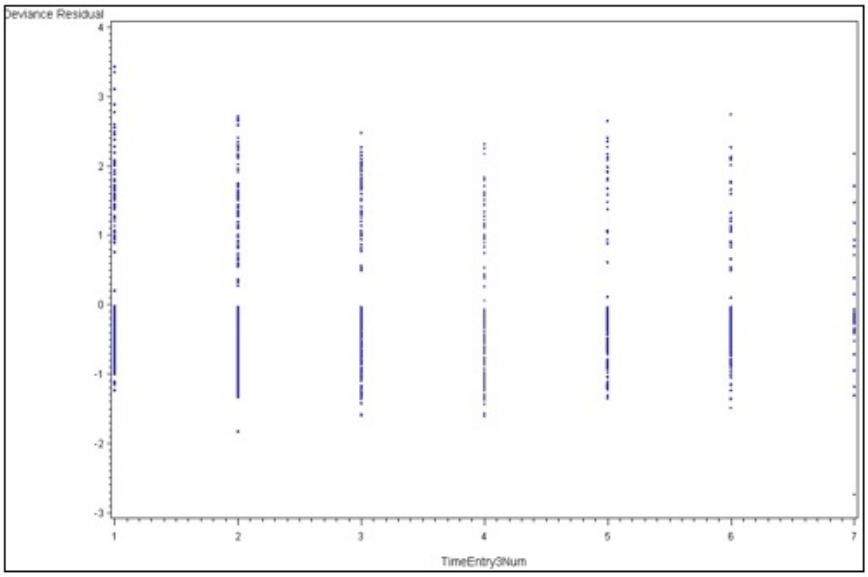


Figure G3. Deviance residuals for time from entry (N=2413)

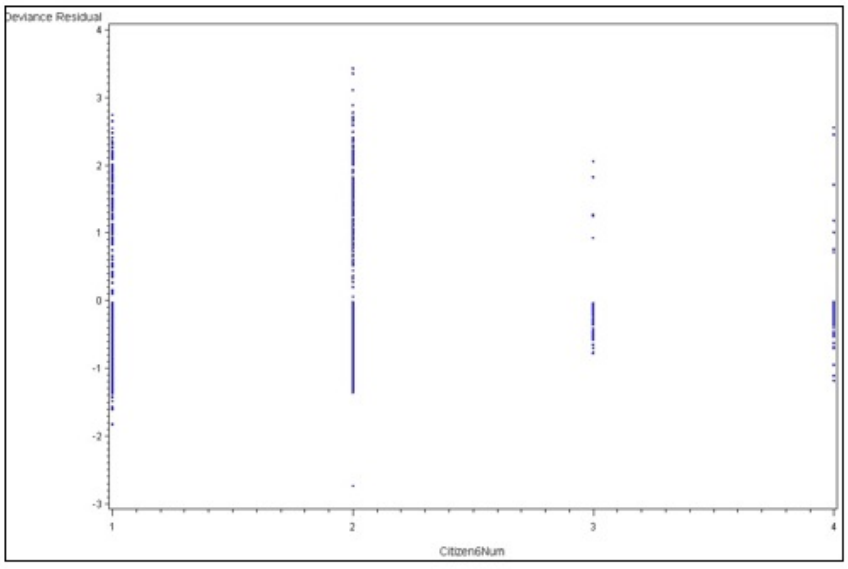


Figure G4. Deviance residuals for citizenship status (N=2413)

Again, in the citizenship status, there are some points above 3 in the permanent resident category (#2), but they do not pose a major problem.

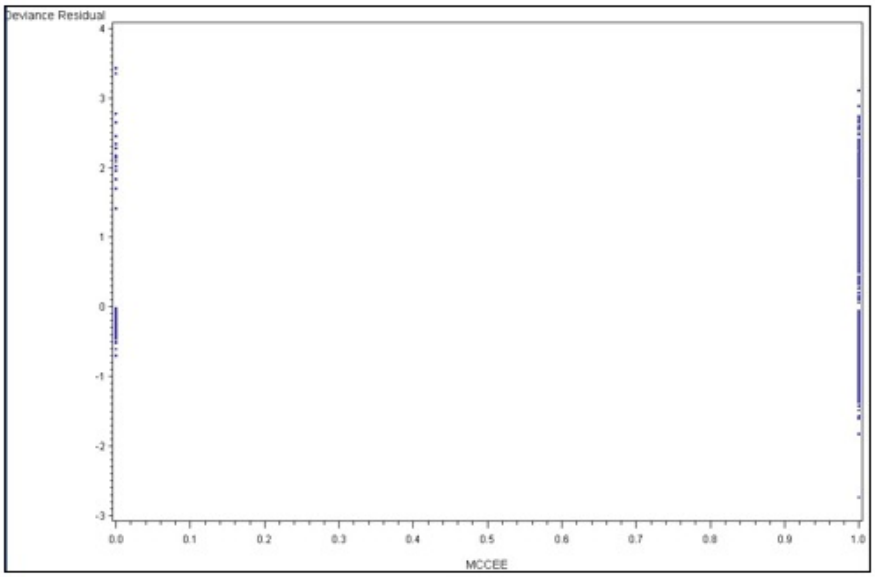


Figure G5. Deviance residuals for Took MCCEE (N=2413)

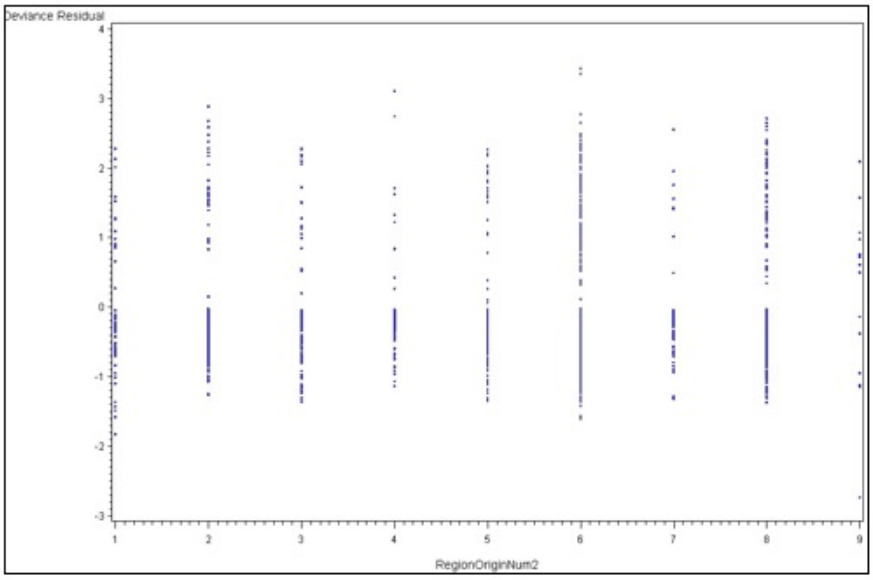


Figure G6. Deviance residuals for region of origin (N=2413)

Schoenfeld residuals are in principle independent of time, so any plot against time should not show any relationship (*Figures G7-G12*). For gender, it appears that the residuals are increasing over time, so this might be a violation of the proportional hazards (PH) assumption; however, the interaction with time is not significant, so that assumption remains

valid; however, gender is only used a control variable, and is not significant in the model, in any case.

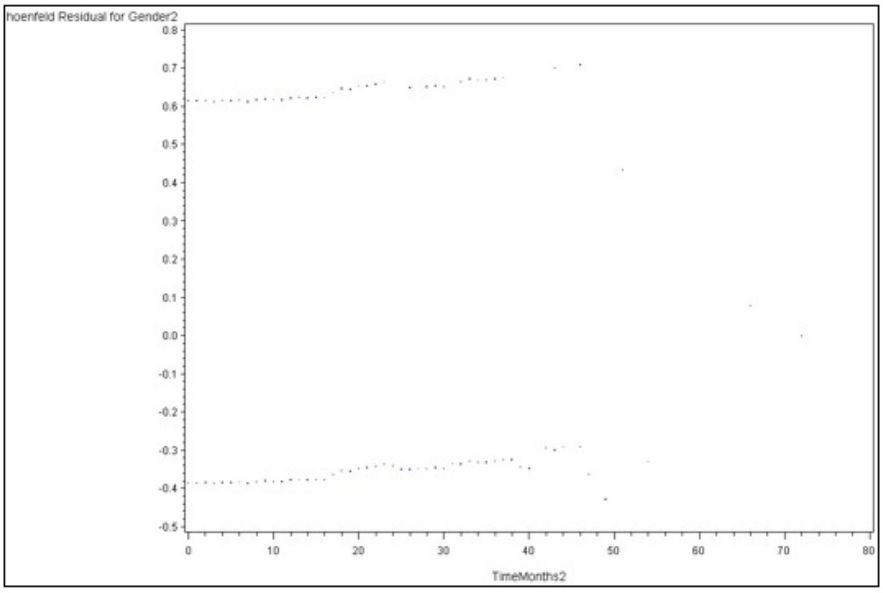


Figure G7. Schoenfeld residuals for gender (N=2413)

For age, there does not appear to be a pattern over time, so the PH assumption holds.

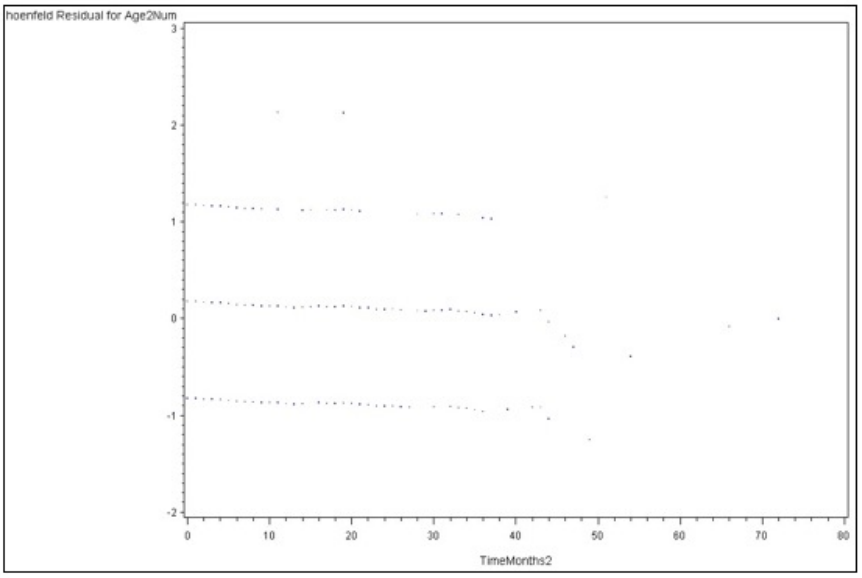


Figure G8. Schoenfeld residuals for age (N=2413)

For time from entry, there does not appear to be a pattern over time, so the PH assumption holds. For citizenship status, there does not appear to be a pattern over time, so the PH assumption holds.

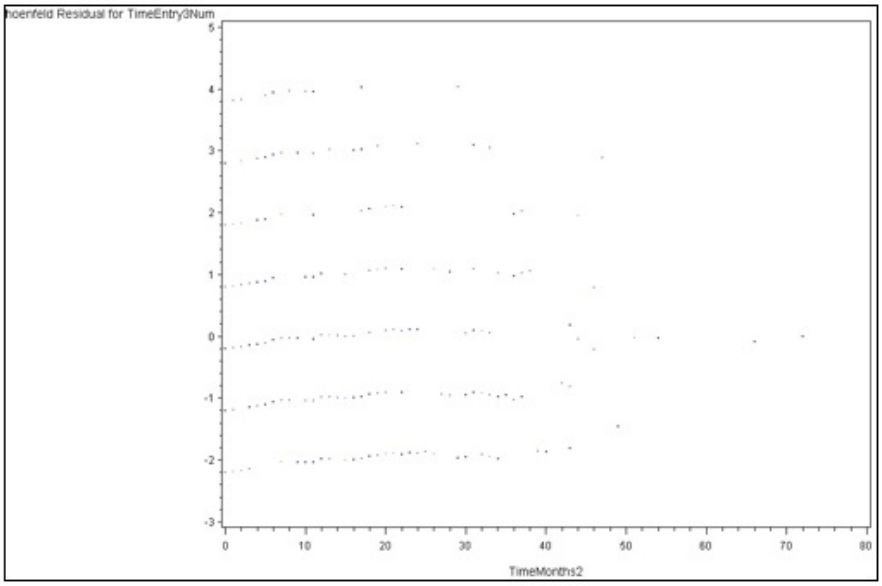


Figure G9. Schoenfeld residuals for time from entry (N=2413)

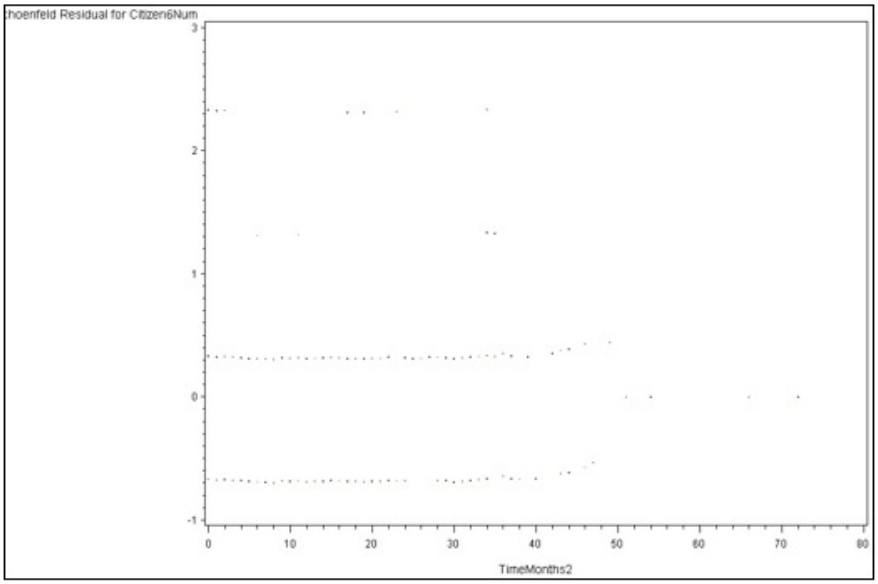


Figure G10. Schoenfeld residuals for citizenship status (N=2413)

For Took MCCEE, there does appear to be a decreasing pattern over time, so the PH

assumption is violated. This means that the interaction of Took MCCEE and time should be included in the model. For region of origin, the PH assumption holds.

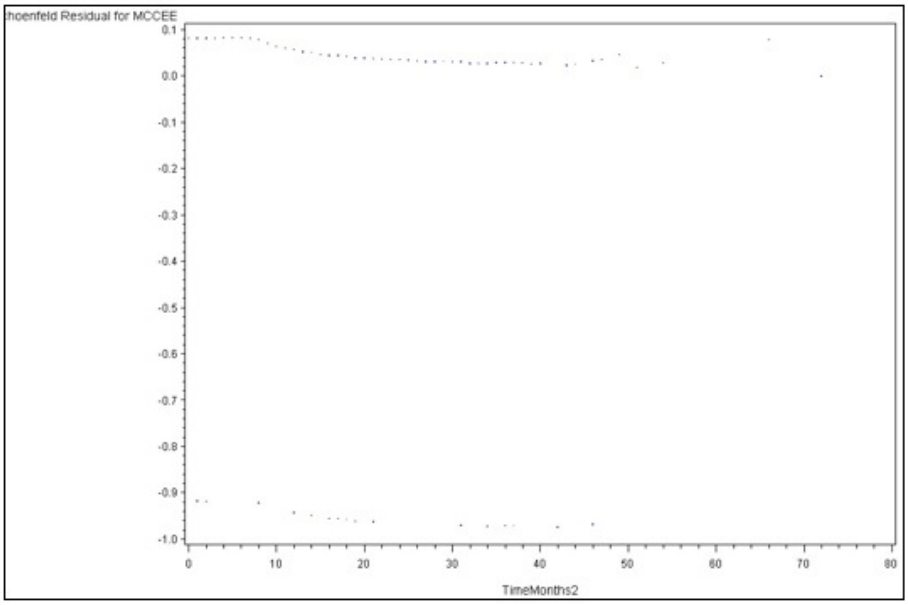


Figure G11. Schoenfeld residuals for Took MCCEE (N=2413)

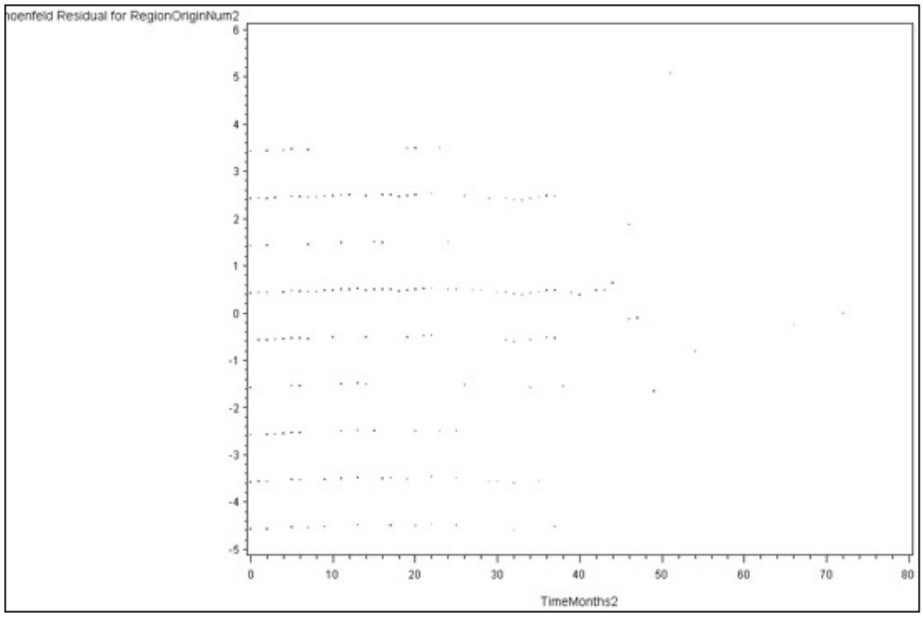


Figure G12. Schoenfeld residuals for region of origin (N=2413)

Appendix J - Letter of permission to the Access Centre's database

The text of the letter is reproduced below. The letter itself cannot be included for compliance with the *Freedom of Information and Protection of Privacy Act* that specifies the removal of phone numbers, home and e-mail addresses as well as signatures.

HealthForceOntario Marketing and Recruitment Agency
Agence de promotion et de recruitment de ProfessionsSantéOntario

October 29, 2010

Ivy Lynn Bourgeault, Ph.D.
University of Ottawa

Re: Jan Olaf D. Jablonski

Dear Dr. Bourgeault,

This letter confirms that Jan Olaf D. Jablonski, a student pursuing his Master's Science in Epidemiology degree at the University of Ottawa has been granted access to the HFO MRA Access Centre database to conduct research on professional integration. Specifically, this research will focus on the professional integration and labour market outcomes of international medical graduates in Ontario, in particular those who registered for services at the Access Centre between 2007 and 2010.

Please let me know if you require additional information or details. We look forward to working with you and Jan on this exciting project.

Sincerely,

Jasmine Singh
Manager, Access Centre

Appendix K – List of acronyms

ACESC	Alliance of Credential Evaluation Services of Canada
AFMC	Association of Faculties of Medicine of Canada
AIPSO	Association of International Physicians and Surgeons of Ontario
CaRMS	Canadian Resident Matching Service
CEHPEA	Centre for the Evaluation of Health Professionals Educated Abroad
CIC	Citizenship and Immigration Canada
CICIC	Canadian Information Centre for International Credentials
CIHI	Canadian Institute for Health Information
CIIP	Canadian Immigration Integration Project
CFPC	College of Family Physicians of Canada
CMA	Canadian Medical Association
CMG	Canadian Medical Graduate
CPSO	College of Physicians and Surgeons of Ontario
CTF	Canadian Task Force on Licensure of International Medical Graduates
DALF	Diplôme approfondi de langue française
DELF	Diplôme d'études en langue française
DILF	Diplôme initial de langue française
FCR	Foreign Credentials Recognition
FCRO	Foreign Credentials Referral Office
FCRP	Foreign Credentials Recognition Program
FQR	Foreign Qualifications Recognition
GOFM	Graduate of a Foreign Medical School
HC	Health Canada
HFO	Health Force Ontario
HRSDC	Human Resources and Skills Development Canada
IEHP	Internationally Educated Health Professional
IEHPI	Internationally Educated Health Professionals Initiative
IELTS	International English Language Testing System
ITWI	Internationally Trained Workers Initiative
IMG	International Medical Graduate
LMCC	Licentiate of the Medical Council of Canada
MCC	Medical Council of Canada
MCCEE	Medical Council of Canada Evaluating Examination
MCCQE1 (2)	Medical Council of Canada Qualification Examination Parts 1 and 2
MD	Medical Doctor
MOHLTC	Ministry of Health and Long-Term Care
MTCU	Ministry of Training, Colleges and Universities
NOC	National Occupational Classification
OECD	Organization for Economic Cooperation and Development
OHREB	Ottawa Hospital Research Ethics Board
PCF	Pan-Canadian Framework for the Assessment and Recognition of Foreign Qualifications
RCPSC	Royal College of Physicians and Surgeons of Canada
SAS	Statistical Application Software
SPSS	Statistical Package for the Social Sciences
TEF	Test d'évaluation du français
TOEFL	Test of English as a Foreign Language
TSE	Test of Spoken English