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## TRAINEE SECTION

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# Strength in Numbers: Growth of Canadian Clinician Investigator Training in the 21st Century

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### Abstract

**Purpose:** Enhancing clinician-investigator (CI) training at Canadian medical schools is urgently needed to bolster the dwindling work force of medical professionals carrying out patient-oriented research in a wide array of medical fields. The purpose of this study is to obtain, from the 15 Canadian medical schools that offer one or more CI training programs, data on the number of trainees, funding levels, attrition rates or other important metrics to evaluate the outcomes of such training efforts.

**Methods:** All Canadian CI programs were surveyed to collect demographic information for the academic year 2010-2011 and compared this to historical data collected by the Association of Faculties of Medicine of Canada (AFMC) and MD/PhD program funding data from the Canadian Institutes of Health Research (CIHR).

**Results:** Over the past decade, enrolment in Canadian CI training programs has increased approximately four-fold. Program-specific funding (CIHR) has also increased, but nearly 50% of MD/PhD trainees are still not supported through dedicated CIHR funding.

**Conclusion:** It is too early to know to what extent this increase in both CI and funding will sustain the workforce of Canadian researchers carrying out patient-oriented research. Monitoring of CI training demographics across Canada, beyond this baseline study, will be essential to measure outcomes from CI training programs and to guide response from funding bodies and policy-makers.

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Clinician-investigator (CI) training has become an area of focus in Canada due to the urgent need for a greater number of medical professionals carrying out patient-oriented research in a wide array of medical fields [1]. At present, 15 of the 17 medical schools in Canada offer one or more programs that combine medical and graduate research training [1,2]. These programs include Clinician Investigator Programs (CIP) (accredited by the Royal College of Physicians and Surgeons of Canada) in which graduate training is obtained during residency, as well as MD/PhD and MD/MSc programs in which graduate training occurs during undergraduate MD education. Although curriculum structure varies between program type and institution, their collective purpose is to provide graduate level research training for medical students and residents.

Evaluation of demographics and funding were key need areas identified by a Canadian study, which recommended improving the clinician-scientist pathway to stimulate the dwindling number of physicians who incorporate research into their careers [3]. Demographic data represent critical information to several key stakeholders and may lead to changes in the number of students aware of (or applying to) each program, increase funding available to trainees, and assist in program and curriculum self-evaluation and accreditation. Unfortunately, gaps in reporting have resulted in a poor understanding of Canadian CI training demographics.

The Clinician Investigator Trainee Association of Canada (CITAC) is a Canadian not-for-profit organization exclusively founded and operated by CI trainees and has a fundamental interest in studying Canadian CI training demographics. CITAC has launched an initiative to collect, analyze and disseminate information regarding the number and distribution of CI trainees in Canadian programs. This initial report aims to provide analysis of basic demographic and funding information to facilitate evaluation of CI training in Canada.

## Methods

CITAC census survey questions were designed to capture demographic data points from each type of CI training program (CIP, MD/PhD and MD/MSc). First, an exhaustive search to identify all CI training programs across Canada was undertaken. Initially, online research at each institution offering training in medicine was completed using publicly available search engines, institutional search engines and manual browsing of institution web sites to identify which institutions offered any of the three CI training programs above. If no program was identified through online research, telephone calls were made to each medical school undergraduate and post-graduate education offices to inquire of the existence of such a

program. The search also undertook to obtain the current contact information of the program offices and directors for each identified program. The findings were cross-referenced with program directors at other institutions to ensure the accuracy of the search and that no program had been overlooked.

Next, the survey was developed by the authors and in consultation with an expert panel including program directors at three different CI training programs (one of each description above). The survey was distributed via email directly to both program directors and program administrators for each CI training program, inviting them to participate and requesting confirmation of their participation. All responses were followed up by either a telephone call or email to the program director's office (either program director or administrative assistant). Follow up communications inquired of the methods by which each program tracks their trainee demographic data. Each program confirmed that they had actively tracked and documented all demographic parameters requested in the survey at least for the current academic year (in this case 2010-2011), if not on an ongoing/historical basis. Responses included the completed survey completed by either the program director or program administrator – although the latter required the approval of program director for participation and verification of data quality. Every institution offering one or more CI training programs agreed to participate and submitted their demographic data for the 2010-2011 academic year. The current (2010-2011) data therefore represents a complete census (100% institution and program participation) of CI training in Canada.

Notably, census data includes all “enrolled” trainees at the point in time data were collected. Enrollment included all trainees in either research or clinical training phases of their respective CI training program. In addition to enrolment, additional data collected included the number of applicants that applied to each program for the 2010-2011 cycle, withdrawals and graduations from each program and gender distribution. No personal identifying data was collected at any point in the study.

Historical enrolment data was purchased by CITAC from the Association of Faculties of Medicine of Canada (AFMC). Enrolment numbers since 1997-1998 for MD/PhD and MD/MSc and since 1999-2000 for CIP programs are included for comparative analysis. AFMC data was collected through undergraduate and post-graduate medical training programs. Therefore, historical data provided by the AFMC may not include all CI trainees enrolled in the graduate/research phases of their programs; however, the number omitted is likely to be a small proportion. It nevertheless points to the need to collect

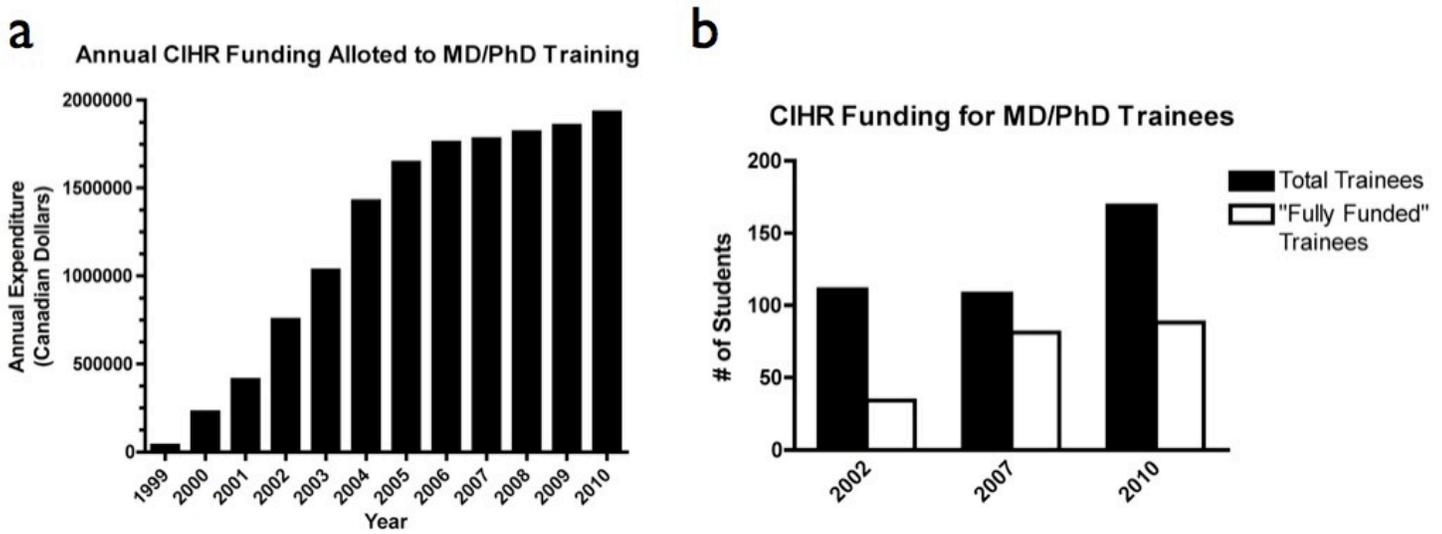


FIGURE 1. MD/PhD training program funding data from the Canadian Institutes of Health Research (CIHR). (a) Total annual, nationally-distributed, sole-source (CIHR) funding for Canadian MD/PhD programs since 1999 including MRC/CIHR MD/PhD studentship award program, the Scriver Family MD/PhD studentship program and the current CIHR MD/PhD program grants. (b) Total dedicated funding from CIHR to Canadian MD/PhD programs was divided by \$22,000 (“full funding” per trainee) to determine the number of fully funded trainee equivalents provided in each year as shown. This number is compared to the total number of MD/PhD trainees at all Canadian institutions enrolled in the same year.

data directly from each CI training program with the purpose of studying CI demographics specifically.

CI trainees obtain funding from a wide variety of sources including provincial and national granting agencies, academic institutions, industry and specialized not-for-profit associations. The diversity of funding opportunities challenges the collection of complete funding data. Therefore, CITAC focused on MD/PhD-specific funding opportunities. This included expenditures dating back to 1999 from the MRC/CIHR MD/PhD studentship award program, the Scriver Family MD/PhD studentship program, and the current CIHR MD/PhD program grants (Fig. 1a).

**Results**

*Changes in CI Training Enrolment*

In 2010-2011, 452 Canadian CI trainees were actively enrolled, including 209 in CIP, 170 in MD/PhD and 73 in MD/MSc programs (Table 1). It should be noted that this data does not include clinician investigator trainees who are not involved in a formal CI training program. When compared with historical data, funding and total enrolment have increased approximately 4-fold since the late 1990s (Fig. 1a, Table 1). This represents an extraordinary rate of growth in CI training over a 12-

Table 1: MD/MSc, MD/PhD and CIP trainee enrolment by year at all Canadian institutions from 1997-2010.

Year	Number of trainees			
	MD/MSc	MD/PhD	CIP	Total
1997	7	53	n/a	60
1999	n/a	n/a	69	69
2002	7	111	93	211
2007	36	108	100	244
2010	73	170	209	452

year period, suggesting that there has been a strong interest in bolstering patient-oriented research by increasing the number of clinician investigators. A similar rise in interest, albeit much longer standing, has been observed in the United States [4]. Additional factors include increased stimulus from provincial governments for graduate enrolment and implementation of funding programs (e.g., CIHR MD/PhD Program grants). Further, between 2007 and 2010, the number of CIP trainees surpassed MD/PhD enrolment, possibly reflecting upward pressure on residents and young physicians to obtain higher-level education to be competitive for jobs.

#### *Distribution of Trainees Across Training Programs and Institutions*

Significant variation in program size was observed across the 15 institutions (Table 2). The University of Toronto has the largest CIP (111 trainees) and MD/PhD (43 trainees) programs in Canada, whereas enrolment in most programs ranges from 5-45 trainees. Enrolment was nearly equal in CIP and MD/PhD programs at six of the 10 institutions, suggesting there may be a complementary relationship between these two particular programs. Active MD/PhD programs are located at 13 institu-

tions, CIP programs are active at 11 institutions and four institutions had active MD/MSc programs at the time of this study.

#### *Trends in Applications, Enrolment and Graduation*

Trends in applications, admissions and exits were surprisingly similar across the country. In total, 349 applications were made to CI training programs in 2010. The majority (~65%) of applications were to MD/PhD programs (Fig. 1b). Of these, only 34 students (15% of MD/PhD applications) successfully obtained admission in 2010-2011. In contrast, the majority of applicants to CIP and MD/MSc programs were granted admission (91% and 86%, respectively). It should be acknowledged that MD/PhD applicants might submit applications to multiple programs to increase the odds of acceptance, more so than CIP and MD/MSc trainees who are already enrolled in residency or MD programs (respectively) at their institution. Our data does not contain information about individual applicants, so we were unable to correct for multiple applications per candidate. Our experience indicates that most applicants apply to 1-3 MD/PhD programs, despite applying to several more MD programs simultaneously. If so, acceptance to MD/PhD programs would still be estimated at only 30%.

Table 2: MD/MSc, MD/PhD and CIP trainee enrolment by program at all Canadian institutions in 2010-2011.

Institution	Number of trainees			
	MD/MSc	MD/PhD	CIP	Total
University of Toronto	0	43	111	154
University of Calgary	27	21	3	51
University of Alberta	0	11	26	37
Universite de Laval	23	14	0	37
McGill University	0	16	19	35
University of British Columbia	0	20	14	34
Universite Montreal	17	8	7	32
Western University	0	19	4	23
McMaster University	0	7	9	16
University of Ottawa	0	4	7	11
Dalhousie University	0	0	8	8
Universite Sherbrooke	6	1	0	7
University of Manitoba	0	4	0	4
Memorial U. Nfld.	0	2	0	2
University of Saskatchewan	0	0	1	1

Relatively low acceptance rates to the MD/PhD programs (*vs.* other CI training programs) may be attributed to differences in the admissions process. Admission to MD/PhD programs tends to be in parallel or extramural to the admissions process for MD programs. This requires application to the MD/PhD stream prior to obtaining admission in the local MD program. In contrast, CIP and MD/MSc trainees are often actively enrolled in a residency or MD program (respectively) at the time of application. There is much discussion in the medical education community regarding the implications and outcomes of these distinct admissions processes, which is beyond the scope of this analysis. Nonetheless, these are important questions to address as the outcomes are potentially different [5].

*Sustainability and Attrition*

It appears that applications to CI training programs are high enough to sustain the current size of each type of training program and, in the case of MD/PhD programs, stimulate further growth if warranted (Table 3). Successful completion of the training program is perhaps an even more important indicator of progress toward training future clinician investigators. Unfortunately, historical data is not available to address this question; however, the CITAC census shows that 101 trainees exited Canadian CI training programs in 2010-2011 (Table 3).

Of these, 76 successfully completed (graduated) the program and 25 (5.5% of enrolled trainees) withdrew without completing all degree requirements (17 CIP, seven MD/PhD and one MD/MSc; Table 3). While case-specific reasons for withdrawing were not collected for reasons of privacy, irreconcilable differences with research personnel/supervisors, personal life crises, change in career goals and lack of funding were most-often cited. Attrition has been experienced and addressed in part by various groups in the United States [6,7]. These studies suggested that career satisfaction as a clinical investigator is strongly influenced by factors such as personal sacrifice and lack of job security.

*Gender Disparity Among CI Trainees*

Historically, enrolment in Canadian faculties of medicine has been predominantly male; however, female enrolment has steadily increased since 1968. In 2010-2011, female enrolment sits at nearly 58% of all medical trainees [8]. Interestingly, only 44% of Canadian CI trainees are female in 2010-2011, a trend which is particularly evident in CIP and MD/PhD programs (Table 3). In contrast, there is nearly a 2:1 female to male trainee ratio in MD/MSc programs. It may be reasoned that female trainees generally prefer to enroll in shorter CI training programs such as MD/MSc; however, CIP programs (58% male enrolment) almost always consist of Masters-length train-

Table 3: MD/MSc, MD/PhD and CIP trainee program applications, admissions, graduation, withdrawal and attrition and enrolment by gender in 2010/2011 across all Canadian institutions.

Demographic	Number of trainees			
	MD/MSc	MD/PhD	CIP	Total
<i>Applications and admissions</i>				
Applications	21	228	70	319
# of trainees enrolled	15	35	64	114
<i>Graduation and withdrawal</i>				
Total trainees enrolled	73	170	209	452
Graduating trainees	15	20	41	76
Withdrawn trainees	1	7	17	25
Withdrawn as % of total	1.4%	4.1%	8.1%	5.5%
<i>Gender distribution*</i>				
Male trainees	16	89	120	225
Female trainees	30	60	89	179
Female trainees as % of total	65.2%	40.3%	42.6%	44.3%

\*U of Calgary data not reported for gender distribution; these trainees not included in gender analysis only.

ing during residency. Alternative explanations, such as a shortage of female role models to encourage interest among female trainees, need to be explored.

### *CIHR MD/PhD Funding*

Funding for CI training programs has been described as a major challenge for program directors regardless of program structure. Trainees are often supported by a wide variety of funding opportunities, making it very difficult to track sources and degree of financial support. The MD/PhD program is unique in that it does have dedicated funding from CIHR to partially support trainees. Expenditures from these dedicated programs over the 1999-2010 time period from CIHR (Fig. 1a) were compared with the total MD/PhD enrolment (Figure 1b): CIHR expenditures have steadily increased over this 11-year period and contributed heavily to the growth of Canadian MD/PhD programs. The current MD/PhD Program Grant is awarded to Program Directors and administered through each institution with flexibility in allocating funds. Under this program, the maximum award per student is \$22,000 annually for up to six years. Total annual expenditure was divided by \$22,000 to approximate the number of "fully-funded" students in a given year. Thus, CIHR MD/PhD-dedicated funding resulted in 31% of trainees (34/111) in 2002, 75% of trainees (81/108) in 2007, and 52% of trainees (88/170) in 2010 being "fully funded". Most programs use this funding to provide scholarships to incoming trainees as a recruitment tool. It is important to note that many trainees must still apply for additional sources of funding (e.g. traditional CIHR PhD Studentships and other local and external opportunities) for support. Alternative sources of funding for MD/PhD students was not explored in this study, but likely account for substantial financial support for students who are not funded through the CIHR MD/PhD dedicated funding programs. Furthermore, CIP programs and MD/MSc programs do not receive dedicated funding, which creates difficulty in tracking and assessing the need for further financial support. An in-depth investigation into financial support for all CI trainees may be helpful in this regard.

### **Discussion**

Training future clinical investigators is critical to linking scientific and clinical research with clinical application. While there are several approaches to achieving this goal, formal CI training programs, including MD/MSc, MD/PhD and CIP programs, are well established and growing rapidly in Canada. Therefore, studying the demographics of these programs is of

interest to multiple stakeholders who will influence or benefit from the activities of clinical investigators.

It should be noted that one of the limitations of this study is that we relied entirely on reporting directly from the program offices that administrate the CI training programs under study. Each program indicated they accurately track all demographic parameters requested in the survey. While we endeavoured to ensure that data collection was accurate, the possibility for errors or inconsistencies in self-reporting is acknowledged and points toward the need for consistent and thorough tracking of Canadian CI trainees in all training program structures. A potential model for tracking of this information in MD/MSc and MD/PhD programs is exemplified through the Royal College of Physicians and Surgeons of Canada, which not only accredits but also tracks enrolment and other demographics in Canadian CIP programs [9]. Tracking completion of thesis defense/equivalent research component (in addition to graduation from MD and graduate degree programs), as is currently the case for CIP programs, would be valuable to understanding the success of MD/PhD and MD/MSc programs in Canada as well.

Key issues identified in our study include the attrition of trainees prior to completion of the degree requirements for each program type. This issue is not new and has been experienced and addressed in part by various groups in the United States [6,7]. The findings of some of these studies suggest that the satisfaction of a career as a clinical investigator may be strongly outweighed by the factors such as personal sacrifice and lack of job security. While job security may be less of an issue in Canada, the strong need for more clinical investigators to be trained suggests that something should be done to address the shortage of enticing factors currently available to attract more physicians toward a career involving research. Included in these enticing factors is the availability of support throughout training programs; for example, we found that only 64% of MD/PhD trainees had complete funding from dedicated CIHR programs in 2010. It is possible that the expenses incurred in CI training programs may contribute to the attrition rate.

### *Gaps in Current Knowledge and Moving Forward*

The rapid expansion of CI training over the past decade suggests strong interest in augmenting patient-oriented research in Canada. Over this same period, funding from CIHR for CI training programs has also increased, but recent plateaus in funding mean many trainees and programs still struggle for financial support. Greater understanding of the diverse nature and extent of funding obtained by this high-needs, elite cohort

is required. Funding for CIP programs historically has been quite variable, with less than 20% of funding coming from CIHR sources [10]. Taken together, it is reasonable to conclude that more robust funding for CI trainees and programs is needed and that need is increasing as enrolment grows. Importantly, financial limitations may be a key component driving the high degree of attrition (5.5% of total enrollment in 2010). Further work to identify specific reasons for withdrawal from CI programs should be completed. Moreover, attrition during training is only one obstacle reducing the number of clinician investigators reaching the 'market'. Although very difficult to study, tracking the activities of trainees *after* completing their program is critically important to determine how many become actively engaged in patient-oriented research.

### Conclusion

CITAC is well positioned as an association to begin to address some of these questions. This will require ongoing census taking and cooperation with CI programs and trainees. Continued monitoring of program demographics and analysis of trainee satisfaction will better inform sustainability of CI training programs, identify factors that impact successful completion of training, and may elucidate underlying reasons for gender disparity. The extent to which these differences impact the career activities and profiles of the clinical investigators each type of program produces will likely not be clear for some time. Once a larger number of graduates from these programs have entered the workforce, these results may be more easily obtained.

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MW and FY designed the study, analyzed data and edited the manuscript. JB collected data and wrote the manuscript. CTA

designed the study, collected and analyzed data and wrote the manuscript. Overall, CTA and JB contributed equally. Without the assistance and participation of the clinician investigator program administrators and directors across Canada, data acquisition for the study would not have been possible.

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