Canadian MD/PhD programs train leaders in clinical and translational research: Outcomes from a national survey of alumni

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ABSTRACT

Background. Combined MD/PhD programs provide a structured path for physician-scientist training. In the United States, outcomes data substantiate the value of the Medical Scientist Training Program (MSTP) as a primary means of training physician-scientists. However, no such data exists for Canadian MD/PhD programs. The absence of quantitative data limits assessment of the success of these programs in training physician-scientists.

Methods. We collected the first national outcomes data by surveying alumni of eight Canadian MD/PhD programs, collectively representing the vast majority of the Canadian graduate population. Our cross-sectional study achieved an overall response rate of 75%.

Results. Our data indicate most alumni pursue careers consistent with their physician-scientist training. 99% of graduates completed residency training and 82% completed at least one postgraduate fellowship. 84% of graduates who completed all training were appointed as faculty at academic institutions, and 53% had been principal investigators on at least one recent funded project. MD/PhD programs appear to effectively prepare trainees for a career integrating research and clinical practice, with 75% of trainees publishing three or more first-author papers during their combined degree and 98% matching to their first choice of specialty.

Interpretation. Continuous funding appears key to supporting trainees, as the median length of physician-scientist training exceeds 13 years, and the majority graduate with substantial debt despite having been supported by CIHR MD/PhD studentships. The results of this national survey demonstrate that Canadian MD/PhD Programs train physician-scientists who assume leadership roles in clinical and translational research.

INTRODUCTION

Physician-scientists receive research training in addition to medical education, and pursue careers applying both. Combined MD/PhD programs, which integrate medical undergraduate and doctoral research training, provide a structured path for trainees to earn both medical (MD) and scientific (PhD) degrees. The concept of an integrated MD/PhD training program originated in the late 1950s, with the realization that the standard medical undergraduate curriculum is insufficient to train investigators as fluent in basic research as they are in clinical care (1). Although combined MD/PhD programs are not the sole path to a career as a physician-scientist, they are among the most prominent (1, 2). Compared to either MD- or PhD-only investigators, MD/PhDs are uniquely trained in both scientific research and clinical practice. This training affords them both the perspective to ask research questions with direct relevance to patient care, and the opportunity to translate their findings into clinical practice.

Health research funding bodies in both the United States and Canada have stressed the importance of translational research. The 2003 mandate of the Canadian Institutes of Health Research (CIHR) emphasized excellence "in the creation of new knowledge and its translation into improved health for Canadians (3)," and its 2015–2020 strategic plan reiterated the importance of "accelerating the discovery, development, evaluation and integration of healthcare innovations into practice (4)." In the United States, the National Institutes of Health (NIH) has identified a "need for investigators who are well trained in both basic science and clinical research (5)." Several lines of evidence support the notion that MD/PhD programs help fulfill the translational research mandate of the CIHR by training skilled physician-scientists. Within Canada, during the period in which CIHR Clinician-Scientist Salary Awards existed, a disproportionate number of these awards went to to researchers holding both MD and PhD degrees (6). Additionally, 89% of physician-scientist alumni of one Canadian MD/PhD program were principal investigators on at least

one research grant, with 78% holding multiple ongoing grants (7). In the United States, MD/PhDs have greater success rates than either MDs or PhDs in their first applications for a NIH R01 grant, and are more likely both to re-apply and to be successful in a subsequent application (8). Moreover, although fewer than 2% of American physicians pursue research as a primary focus of their careers (9), an analysis of graduates of one large American MD/PhD program reported that more than 90% of graduates considered research a significant component of their current position (10).

Despite compelling evidence that physician-scientists, and MD/PhDs in particular, make significant contributions to translational research, commentators have repeatedly expressed concerns about a decline in the number of physician-scientists being trained (8, 11, 12). A 2011 international review panel report to the CIHR expressed “concern about the support for clinician-scientists, many of whom have 50% time or less for research,” and recommended the development of a national strategy to support translational research (13). A 2013 report by an external advisory committee to the CIHR Strategy for Patient-Oriented Research recommended expanding the scope of MD/PhD program funding and creating new funding opportunities for non-MD/PhD clinician-scientists (14). Several factors have been proposed to underlie the perceived endangerment of the physician-scientist workforce, among which are the financial disincentives to pursuing a career as a physician-scientist. The extended training time of combined MD/PhD programs, which are typically followed by residency and often also by clinical or research fellowships, requires young researchers to accept significant lost or deferred income relative to peers entering clinical practice only (15). Lost lifetime earnings are typically exacerbated by the disparities in income between practicing medical specialists and individuals involved primarily in research (11).

In the United States, a significant body of research substantiates the value of the Medical Scientist Training Program (MSTP), both at individual schools (2, 10, 16, 17) and

in national analyses (1, 18-20). However, little parallel data is available concerning Canadian MD/PhD programs (6). The paucity of outcomes data within Canada limits assessment of whether MD/PhD programs are meeting their goal of training leaders in clinical and translational research. The lack of quantitative data regarding MD/PhD program graduates is particularly relevant in light of the recent decision by the CIHR to terminate funding for MD/PhD programs. We therefore sought to evaluate the degree to which Canadian MD/PhD programs contribute to the CIHR mandate of translating new knowledge into improved healthcare for Canadians. We collected outcomes data by surveying alumni of eight Canadian MD/PhD programs, and investigated the demographics, education, career trajectory, publication and funding records, and debt of Canadian MD/PhD program graduates. The results of this nationwide survey provide empirical evidence in support of the role of combined MD/PhD programs in training physician-scientists who assume leadership roles in translating biomedical advances into improved patient care.

Methods

We developed and implemented a web-based survey consisting of 41 questions designed to assess the demographics, education, career trajectory, publication and funding records, debt, and career and lifestyle satisfaction of MD/PhD program graduates. Eight Canadian MD/PhD programs (University of Alberta, University of British Columbia, University of Manitoba, McGill University, McMaster University, Université de Sherbrooke, University of Toronto, and University of Western Ontario) agreed to participate in the survey. Institutional research board approval was obtained to distribute the survey to Canadian MD/PhD program graduates from the University of British Columbia Behavioural Research Ethics Board (H15-02871). A pilot survey was distributed to graduates of the University of British Columbia MD/PhD program, and a revised survey was distributed to the entire

survey population. Graduates were contacted up to six times by email, twice by phone, and once by mail. Only trainees who had graduated from MD/PhD programs prior to September, 2015 were surveyed.

The survey was conducted using survey tools in Google Forms. Responses were not initially anonymized, in order to ensure respondents did not inadvertently complete the survey twice, but were subsequently anonymized prior to data analysis. Five individuals completed the survey twice; only their second response was retained. Respondents were required to complete 17 of the 41 questions, but responses were not required for the remaining 24 questions. Percentages were therefore calculated relative to the number of respondents who answered each question. Respondents were divided into individuals who had completed all training, and individuals who were still in training. Respondents were considered to have completed all training if they reported they had completed residency training or did not intend to complete residency training and did not list the title of their current appointment as “Clinical fellow/research fellow.” One respondent did not provide information about career stage and was excluded from analysis of graduates by career stage.

RESULTS

Demographics

Of the 186 alumni of combined MD/PhD programs at eight participating institutions who graduated before September 2015, 139 completed the survey, for an overall response rate of 75%. Contact information could not be identified for five graduates; the response rate among contacted alumni was therefore 77%. 49% of respondents were still completing residency or clinical or research fellowships, while 50% had completed all training (*Methods*). Response rates at individual schools ranged from 50% to 100% (median 81%), while the number of graduates from each institution ranged from one to 73 (median 19.5)

(Fig. 1A). Consistent with previous data from a survey of MD/PhD programs (21), our data indicate Canadian MD/PhD programs have undergone a significant expansion over the last two decades (Fig. 1B), with more than twelve times as many trainees graduating between 2010–2015 as between 1990–1995 (87, 7, respectively). Graduates were predominantly male (73%) and white (57%) or Asian (28%). Although the proportion of female graduates has increased in recent years, from 0% between 1990–95 to 34% between 2010–15 (Fig. 1C), it remains well below the 50% of female matriculants within the UBC MD program, or the 54% of female matriculants within the McGill MD program, over the latter time period (22, 23).

Education

The median time from MD/PhD program entry to graduation was 7.7 years. 26% of alumni took 8 or more years to graduate, with 10% spending 9 or more years in a combined program. Prior to entering an MD/PhD program, 83% of respondents completed a Bachelor of Science (B.Sc.), 11% completed a Bachelor of Health Sciences (B.HSc.), and 7% completed another bachelor's degree. Only 23% of respondents entered MD/PhD programs holding master's degrees.

Alumni who felt their physician-scientist training was complete were asked to state the total length of their training in years, including residency, fellowships, and all other training they felt had contributed to their career as a physician-scientist since entering a MD/PhD program. The median total length of all physician-scientist training from MD/PhD program entry to completion of all training was 13.5 years. The long median training time can likely be attributed to the fact that the majority of alumni had either completed (59%) or were currently completing (40%) residency; only two alumni did not plan to complete residency training. The majority of respondents who had completed residency additionally pursued clinical (66%) or research (38%) fellowships, with 22% completing both clinical

and research fellowships and only 18% reporting no postdoctoral training. Among respondents who completed or were currently completing residency training, 98% matched with their first choice specialty, and 90% matched at their first choice location. The most common specialties among Canadian MD/PhD program graduates were internal medicine (23%), pediatrics (8%), anatomical pathology (7%), diagnostic radiology (7%), and neurology (6%) (Table 1). The popularity of these specialties is consistent with the experience of American MD/PhD programs (1, 18). Canadian MD/PhDs were also approximately as likely as their American counterparts to pursue a surgical specialty, with 11% of Canadian alumni matching to a surgical residency compared to 11–12% of American graduates (1, 18). 94% of graduates indicated that they pursued an identifiable medical specialty, considerably more than the 52% of Canadian MDs who described themselves as specialty physicians (24).

Graduates were asked to describe their agreement with questions designed to evaluate their satisfaction with their training on a Likert scale (Table 2). In general, graduates expressed satisfaction with both medical education (93% agreeing or strongly agreeing) and physician-scientist training (85% agreeing or strongly agreeing). Moreover, graduates generally agreed or strongly agreed that they would complete a MD program (91%), a PhD program (78%), or a combined MD/PhD program (73%) again, if they could revisit their choices.

Career trajectory

The majority of MD/PhD program graduates who had completed all training reported that their current appointment was at an academic institution (84%) or in private or hospital clinical practice (24%) (participants had the option of selecting more than one organization type). Only three graduates who had completed all training reported their current appointment was at a government or private research institute or in industry; none were

unemployed. The proportion of MD/PhDs appointed in an academic institution is considerably higher than the proportion of Canadian general practitioners (11%) or specialists (41%) working in academic centres (24). These figures are comparable to data from a survey of 5,969 American MD/PhD program graduates, which reported that 81% of graduates were employed in academia, research institutes, or industry, while 16% were in private practice (1). All but four Canadian alumni who had completed all training were appointed within Canada (74%) or in the United States (20%). 84% of individuals who had completed all training were appointed at the level of assistant professor or higher, while 10% reported appointment at the level of instructor/adjunct professor and 6% reported their title as clinician or equivalent (Table 3). 63% of graduates who completed all training had protected research time, among whom 72% of individuals appointed at an academic institution had protected research time (Table 3). After completion of all training, on average, graduates reported dedicating 34% of their time to research, 51% to clinical practice, 10% to teaching, 7% to administration, and 1% to other duties (Table 3). 62% of graduates who had finished all training, and 74% of those appointed at academic institutions, dedicated at least 20% of their time (one day a week) to both research and clinical practice. Although only 36% of graduates who had completed all training dedicated 50% or more of their time to research, just 14% reported they were not involved in research at all.

Survey participants were asked to rate the degree to which they were involved in translational, clinical, basic science, or health services research. Respondents were provided with definitions of translational, clinical, and basic science research from Rubio *et al.* (25), and the definition of health services research employed by the CIHR (26). Graduates primarily reported involvement in clinical research (62% agree or strongly agree) or translational research (58% agree or strongly agree), and were less likely to agree that they were involved in basic science research (38% agree or strongly agree).

They generally were not involved in health services research (17% agree or strongly agree). The range of research areas are consistent with the aim of MD/PhD programs in training leaders in clinical and translational research.

Participants also answered more general attitude questions about their current appointment. 85% of graduates agreed or strongly agreed that the combined MD/PhD degree helped their career, while 72% of graduates agreed or strongly agreed that they would be substantially involved in research in the future. Only 51% of graduates agreed or strongly agreed that they were happy with their work-life balance, although this figure rose to 66% when individuals still completing training were excluded.

Finally, participants answered attitude questions about the landscape of Canadian physician-scientist training and funding. The vast majority of respondents agreed or strongly agreed that Canada should train more MD/PhDs (84%), and that the CIHR should fund Canadian MD/PhD programs (87%), with only 6% and 5% (respectively) disagreeing or strongly disagreeing.

Publications, funding, and debt

Two important indicators of research activity are the publication record of an investigator and their ability to successfully obtain competitive research funding. At the time they completed the survey, 92% of MD/PhD program graduates had authored a peer-reviewed manuscript within the past 36 months, while 72% had authored a peer-reviewed manuscript within the past 12 months. These proportions were similar for MD/PhD program graduates who had completed all training (93% and 77%, respectively). Moreover, more than half (53%) of graduates who had completed all training had been the principal investigator on a recent, funded project within the past 36 months (44% within the last 12 months). These proportions were higher when considering only graduates employed within academic institutions (62% and 52%, respectively), and the former is

comparable to the 61% of American MD/PhD alumni working within academia who had identifiable research funding (1). Among graduates who had completed all training and were employed in an academic institution, the most common sources of funding were private or extramural funding organizations (43%), charitable foundations (43%), and CIHR (38%). 47% reported receiving funding from CIHR, the Natural Sciences and Engineering Research Council of Canada (NSERC), or another federal granting agency. Together, these observations provide further support for the notion that MD/PhDs generally remain significantly involved in research after completing their training, and successfully obtain competitive research funding.

The publication records of MD/PhDs during the course of their combined degree indicate that these programs successfully train individuals with strong research backgrounds. 33% of alumni published five or more first author papers during their combined degree, while 75% published three or more, and only 4% were not first authors on a peer-reviewed manuscript. With respect to co-authorships, which often reflect additional collaborative research work beyond the thesis itself, two-thirds (65%) of graduates co-authored four or more peer-reviewed manuscripts during their combined degree, while only 5% did not co-author a single peer-reviewed manuscript.

We additionally evaluated the funding received by graduates during the course of their MD/PhD degree, and the outstanding debt incurred during medical education and physician-scientist training. Almost all graduates reported at least one funding source during physician-scientist training, with the most common being CIHR MD/PhD program funding (72%). Other common sources were other CIHR funding (23%), charitable foundations (19%), and other federal (15%) or provincial (13%) funding agencies. Only a single graduate reported that they did not receive any funding during physician-scientist training. However, the majority (60%) nevertheless carried debt after completing their

physician-scientist training, with 51% graduating with more than CAD$20,000 in debt and 38% graduating with more than CAD$50,000 in debt.

INTERPRETATION

MD/PhD programs represent a significant investment of resources, including substantial federal funding. In the United States, MD/PhD programs receiving MSTP grants from the National Institute of General Medical Sciences (NIGMS) are required to track their graduates and report their activities every five years (1), and several large national analyses have reported analyses of cohorts including thousands of MD/PhD program graduates (1, 18-20). However, in the absence of outcomes data for Canadian programs, funding decisions are made without quantitative evidence to substantiate or discredit the value of Canadian MD/PhD programs as a primary structured training path for physician-scientists.

Recently, the first outcomes analysis of a Canadian MD/PhD program was published, drawing on data from a survey of 30 alumni of McGill University (7). Canadian clinician-investigator training programs, including MD/PhD programs, have also been surveyed directly in order to collect data on program size and funding (21). A third study compared grant and award performance of Canadian clinician-scientists and non-clinical PhDs between 2000–2008 (27), finding that clinician-scientists held approximately 35% of total CIHR funding in 2008, and that the growth rate in grant funding for clinician-scientists over the study period was five times that for non-clinical PhD researchers. However, the definition of ‘clinician-scientist’ employed within this study included both MDs and nurses with and without PhDs, complicating direct evaluation of MD/PhD program outcomes. Moreover, only data within the CIHR Funded Research database was analyzed, thereby excluding clinician-scientists funded by other federal, provincial, or external granting agencies, or clinician-scientists without identifiable external research funding.

The data presented here therefore represents the most comprehensive characterization of Canadian MD/PhD program outcomes to date. The participating programs collectively constitute the vast majority of the Canadian MD/PhD graduate population. Moreover, by surveying alumni directly, the present study provides unique data concerning the education, career trajectory, publication and funding records, debt, and career and lifestyle satisfaction of MD/PhD program graduates relative to previous studies, which have leveraged data from public funding databases (27) or surveys of physician-scientist training programs (21).

Although this study provides new and comprehensive data characterizing Canadian MD/PhD program graduates, several limitations should be considered in interpreting the results. The response rate of 75% (77% among contacted graduates) excludes about a quarter of alumni from the eight participating programs. Moreover, one Canadian MD/PhD program was excluded from the survey (University of Calgary), as this program includes individuals who have completed, or nearly completed, a PhD before entering medical school, and therefore only a small fraction of graduates have completed an integrated MD/PhD as delivered across the rest of Canada. It is therefore possible that survey respondents are not representative of the entire population of Canadian MD/PhD program alumni, though the relatively high response rate mitigates the impact of non-response bias on the results. Finally, the low median respondent age of 37 has the potential to bias results concerning the career trajectories of MD/PhDs, since early-career investigators may be less likely to hold identifiable funding or have protected research time. The difficulty identifying current contact information and, in some cases, even the names of Canadian MD/PhD program graduates suggest a need for coordinated tracking of alumni, as is required by American MSTP programs receiving NIGMS funding (1).

Despite the limitations of the present study, several conclusions can be drawn. A primary goal of combined MD/PhD programs is to produce graduates who leverage their

training in both research and clinical practice in careers as physician-scientists. MD/PhD program graduates generally pursued further training consistent with such careers, with 99% entering residency programs and 82% completing postgraduate clinical or research fellowships. Upon completing all training, 84% of alumni were appointed at an academic institution, among whom 72% had protected research time in their current position. The majority of alumni who had completed training and were appointed at an academic institution dedicated the equivalent of at least one day a week to both research and clinical practice, and nearly two-thirds (62%) had been the principal investigator on a recent funded project. Moreover, within this population, 91% dedicated at least some time to research in their current position, only 9% disagreed or strongly disagreed that they would be substantially involved in the future, and all but two had co-authored a peer-reviewed manuscript within the last 36 months. Thus, most Canadian MD/PhD program graduates do follow career paths consistent with their physician-scientist training.

However, the concerns expressed by a 2011 CIHR International Review Panel about clinician-scientists with 50% or less time for research are borne out in our data. On average, graduates who had completed all training dedicated only 34% of their time to research, and only 36% reported dedicating 50% or more of their time to research. The proportion of MD/PhDs dedicating 50% or more of their time to research was slightly higher in academia (44%), but considerably lower than in a survey of American MD/PhD program graduates (64%) (1). The 2011 report noted that it is “hard to imagine clinician-scientists with 50% or more time in the clinic making seminal contributions to science” (13). This may explain in part the observation that 24% of alumni appointed in an academic institution have left Canada, suggesting Canada may have a problem retaining some highly skilled physician-scientists.

It is noteworthy in this respect that the majority of graduates who had completed all training entered academia (84%), and were appointed at the level of assistant professor or

higher (84% of academics). The fact that Canadian MD/PhD graduates typically pursue careers in academia, yet dedicate less time to research than American MD/PhDs, may suggest a lack of opportunities including protected research time for academic clinician-scientists within Canada. In particular, academic health sciences centres within Canada may not be structured to support physician-scientists in positions with the majority of time dedicated to research, particularly given the decline of federal funding programs to support the salary of both clinician-scientist and PhD-only investigators. This may underlie the dramatic difference between the proportion of Canadian and American graduates who reported significant involvement in basic science research (38% vs. 57%), as clinical research is likely easier to integrate into a predominantly clinical appointment than an independent basic research program. However, other outcomes of research activity suggest that Canadian graduates continue to be substantively involved in research despite having less protected research time than their American counterparts. In particular, it is striking that similar proportions of Canadian and American MD/PhDs appointed in academia held identifiable research funding (62% and 61%, respectively) (1), suggesting Canadian graduates are able to successfully secure funding and lead projects even while dedicating less than half of their time to research.

Despite the general tendency for MD/PhD program graduates to pursue careers as physician-scientists, a significant fraction did not utilize their research training at their current appointment, nor plan to do so in the future. 14% of respondents who had completed all training reported that they dedicated no time at all to research at their current appointment, and 14% disagreed or strongly disagreed that they would be substantially involved in research in the future. These figures are similar to the 16% of American alumni who eventually enter private practice, and the 13% of American alumni who indicated that they were not involved in research (1). Brass *et al.* speculate that the undesirably high proportion of graduates who exit research simply reflect “the challenges of predicting what

a 21-year-old applicant will actually do when he or she is 30 to 40 years old" (1). However, it is noteworthy that only 23% of those respondents who dedicated 40% or less of their time to research disagreed or strongly disagreed that they would be substantially involved in research in the future, further suggesting a lack of opportunities for physician-scientists to effectively integrate research and clinical practice in Canada.

Canadian MD/PhD programs themselves appear to provide excellent training for graduates to pursue careers integrating research and clinical practice. 75% of alumni published three or more first-author papers while completing their combined degree, and only 4% of alumni failed to co-author a peer-reviewed manuscript resulting from their training. Upon graduation from their combined program, 98% of graduates matched to their first choice of residency, a figure that is approximately 10% higher in absolute terms than the national average for all medical undergraduates over the period from 1993 to 2015 (28). This difference is compounded by the higher proportion of MD/PhD graduates who pursued residency training in a medical specialty, rather than in family medicine. These factors are reflected in the agreement by 85% of graduates that the combined MD/PhD had helped their careers.

Canadian MD/PhDs spent a median of 7.7 years completing their combined degree, and 13.5 years in total pursuing physician-scientist training. The considerable financial disincentives to pursuing such lengthy training have long been recognized (12). Nonetheless, it is striking that only a single graduate did not report receiving any source of funding during their training. CIHR MD/PhD studentships in particular represented a key source of funding for physician-scientist trainees, with 72% of respondents having received support from this dedicated source, yet the majority still graduated with at least $20,000 in debt. Funding sources designed for PhD students typically span at most three years, and therefore cannot ensure continuous support for students throughout the long duration of physician-scientist training. The first-hand experience of difficulty securing continuous

funding, and reliance on CIHR studentships, may account for the consensus among respondents (87%) that the CIHR should continue to fund Canadian MD/PhD programs.

In summary, our data provide empirical evidence that Canadian MD/PhD program graduates generally continue to pursue careers as physician-scientists, and that many assume leadership roles in clinical and translational research. However, our data raises concerns about the career opportunities available within Canada for graduates who seek to integrate research with clinical practice. Despite differing in many respects from MD- and PhD-only graduates, they are comparable in many respects to their American MD/PhD counterparts, suggesting data from the United States may generally reflect trends within the Canadian physician-scientist workforce. Our data supports the value of combined MD/PhD training within Canada and provides quantitative data to inform policy decisions with relevance to physician-scientist training and support for clinical and translational research.

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AUTHOR CONTRIBUTIONS

M.A.S., J.W.S., D.D.W.T., J.X.J., N.D.R., and L.A.R. developed the survey tool, with input on the overall concept of the project from A.K., X.W., P.E.S., and K.Z.; all authors approved the survey tool. M.A.S., J.W.S., D.D.W.T., J.X.J., P.E.S., A.K.D., E.-R.G., K.T.H., J.F.L., D.A.U., and L.A.R. contacted graduates. M.J.E., E.-R.G., K.T.H., J.F.L., P.J.M., N.D.R., D.A.U., and L.A.R. provided MD/PhD program graduate contact information. A.K. and D.A.U. coordinated efforts for the Clinician-investigator Trainee Association of Canada (CITAC) and the Canadian Society of Clinical Investigation (CSCI), respectively. M.A.S. analyzed data and wrote the manuscript, with contributions from J.W.S., D.D.W.T., J.X.J., N.D.R., and L.A.R. All authors read and approved the manuscript. M.A.S., J.W.S., D.D.W.T., J.X.J., and L.A.R. had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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FIGURE LEGENDS

Figure 1. Demographics of Canadian MD/PhD graduates and survey respondents. (*A*) Response rate among graduates at participating institutions. (*B*) Response rate by graduation year. (*C*) Female and male Canadian MD/PhD program graduates by graduation year.

TABLES

Table 1. Residency choices of Canadian MD/PhD program graduates.

Specialty	Number of respondents	Percentage of respondents
Internal Medicine	31	23.5
Pediatrics	10	7.6
Anatomical Pathology	9	6.8
Diagnostic Radiology	9	6.8
Neurology	8	6.1
Other	8	6.1
Anesthesiology	7	5.3
Dermatology	6	4.5
Neurosurgery	6	4.5
Ophthalmology	6	4.5
Psychiatry	6	4.5
General Surgery	4	3.0
Obstetrics and Gynecology	4	3.0
Hematological Pathology	3	2.3
Radiation Oncology	3	2.3
Emergency Medicine	2	1.5
Medical Genetics	2	1.5
Medical Microbiology	2	1.5
Neuropathology	2	1.5
Otolaryngology—Head and Neck Surgery	2	1.5
Plastic Surgery	2	1.5

Table 2. Canadian MD/PhD program graduate responses to Likert questions.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Overall, I am satisfied with the quality of my medical education.	1	1	7	53	76
Overall, I am satisfied with the quality of my clinician-scientist training.	1	3	17	54	61
If I could revisit my choice, I would choose to attend medical school again.	3	0	10	39	86
If I could revisit my choice, I would choose to attend a PhD or combined PhD program again.	6	8	16	47	59
If I could revisit my choice, I would choose to attend a MD/PhD program again.	9	6	22	43	57
I am engaged in translational research.	29	9	19	32	46
I am engaged in clinical research.	17	14	20	48	36
I am engaged in basic science research.	44	23	17	18	33
I am engaged in health services research.	80	10	21	17	6
I will be substantially involved in research in the future.	8	7	24	38	61
The combined MD/PhD degree has helped my career.	1	7	13	40	77
I am satisfied with my work-life balance.	4	23	39	56	13
I believe that Canada should train more clinician-scientists.	3	5	14	40	76
I believe the CIHR should fund Canadian MD/PhD programs.	3	4	11	21	99

Table 3. Outcomes related to research activity for individuals still completing training, individuals having completed all training, and the subset of graduates within the latter group appointed in academic institutions.

	In training	Done all training	Academics
	68 (49%)	69 (50%)	57 (41%)
Title at current appointment			
Resident	54	0	0
Clinical fellow/research fellow	14	0	0
Instructor/adjunct professor	0	7	4
Assistant professor/staff scientist	0	38	35
Associate professor/senior scientist	0	14	12
Professor/section chief	0	7	6
Clinician	0	4	1
Protected research time at current appointment			
No	35	26	16
Yes	33	44	42
Percent time dedicated to research at current appointment			
0%	12	10	5
10%	33	13	8
20%	11	10	9
30%	3	6	6
40%	0	5	4
50%	0	5	5
60%	1	6	6
70%	3	10	10
80%	1	4	4
90%	2	0	0
100%	0	0	0
I will be substantially involved in research in the future			
Strongly disagree	3	5	3
Disagree	2	5	2
Neutral	12	12	8
Agree	21	17	15

Strongly agree	30	31	30
Recent co-authored peer-reviewed manuscript			
No	6	5	2
Yes, within the last 12 months	45	54	50
Yes, within the last 36 months	16	11	6
Principal investigator on recent funded project			
No	N/A	33	22
Yes, within the last 12 months	N/A	31	30
Yes, within the last 36 months	N/A	6	6
Funding since completing clinician-scientist training			
CIHR	N/A	22	22
NSERC	N/A	7	7
Other federal granting agency	N/A	13	11
National/international charitable foundation	N/A	25	25
Private/extramural	N/A	27	25
Intramural	N/A	3	3
Other	N/A	7	6
I have not received funding since completing my clinician-scientist training	N/A	41	25