The Henry G. Friesen
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in Health Research

LE PRIX INTERNATIONAL
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Friesen International Prize Program

"The Future of Graduate Education in Canada: New Directions".

Proceedings of a Policy Roundtable
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Amis des instituts de recherche en santé du Canada
FCIHR/AIRSC
Friends of Canadian Institutes of Health Research

CANADA 150

Celebrating Science and Administrative Leadership

The Henry G. Friesen International Prize in Health Research is awarded in recognition of the distinguished leadership, vision and innovative contributions of Dr. Henry G. Friesen. The prize supports an annual Public Forum and luncheon address to the Canadian Academy of Health Sciences (CAHS). Through the partnership of CBC Radio One Ideas, the lecture is broadcast to reach the broadest possible audience.

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Message From the Presenting Organization

Dr. Aubie Angel

Dr. Aubie Angel CM., MD, MSc, FRCPC, FCAHS,
President of Friends of CIHR
Roundtable at U Ottawa & FCIHR Forum at CSPC2017

This is the 3rd in a series of Roundtables with a focus on career development of young researchers. In 2015, we addressed the question: “Are we training too many PhDs?” and the consensus was clearly the opposite. In fact, the recommendations from the gatherings favoured expanding graduate programs, given the vital role that advanced education contributes to social well-being, economic enhancement and international competitiveness in a knowledge-based economy. In 2016, FCIHR, in collaboration with the Banting Research Foundation (BRF) and the Royal Canadian Institute for the Advancement of Science (RCIS), organized a Roundtable in conjunction with CSPC2016 on: “The Role of Early Career Scientists in Research Policy Development”. We take the view that greater participation by early career scientists in policy development will enhance their careers and advance Canada’s leadership in health research. The 2017 Roundtable at U Ottawa entitled: “The Future of Graduate Education in Canada: New Directions” focuses on a better understanding of multiple career paths of PhD graduates, as clearly documented by a study coming out of the University of Toronto, School of Graduate Studies, and reported by Dr. Reinhart Reithmeier. His analysis confirms the wider experience that 70% of PhD graduates end up in a variety of careers other than that of the university professoriate. This reinforces the need for a revised curriculum that prepares graduate students for the skills essential in the wider marketplace.

Dr. Reithmeier’s address, “10,000 PhDs Project: Implications for Graduate Education”, will be of interest at all levels of the educational ladder. Students and policy leaders alike will now have a factual basis for planning their personal careers or priorities for institutional investments respectively.This Roundtable assembled a panel of experienced leaders from across the country on Canadian graduate education who will share their individual perspectives on future priorities and opportunities.

Friends of CIHR would like to thank the speakers for their generosity of time and for sharing their wisdom, expertise and novel initiatives as we address the future challenges of graduate education in Canada.

Friends of CIHR is particularly grateful to the University of Ottawa Office of the Vice President Research for its dedicated support of the 2017 Friesen Prize Program and for hosting the Friesen Lecture and Policy Roundtables. Acknowledgement

We thank the participants for their generosity of time and for sharing their wisdom, expertise and novel initiatives to address the future challenges of graduate education.

- Dr. Aubie Angel
President FCIHR

Roundtable

"The Future of Graduate Education in Canada: New Directions"

Co-Chairs

Dr. Ruth Slack

Dr. Ruth Slack, PhD, FRSC
Interim Vice Dean, Research, University of Ottawa

Dr. Ruth Slack is a professor and Vice-Dean, Research (interim) at the Faculty of Medicine of the University of Ottawa. She has served in academic leadership as Assistant Dean Graduate and Postdoctoral Studies for 10 years, in addition to chairing numerous CIHR committees and serving on the Board of Directors for the Canadian Stroke Network, the Bruyère Hospital Research Institute and the Canadian Association for Neuroscience. She leads a highly productive research laboratory dedicated to uncovering novel approaches to enhance the brain's regenerative capacity, which is supported by a CIHR Foundation grant, Heart and Stroke Foundation of Canada, Brain Canada and Krembil Foundation. In 2017, she was elected a fellow of the Royal Society of Canada

Mr. Paul Davidson

Mr. Paul Davidson, BA, MA
President Universities Canada

Universities Canada. Paul Davidson has played leadership roles in government, the private sector and the voluntary sector for over 25 years. At Universities Canada, he has led a process of organizational renewal and greater member engagement, achieving increases in research funding, resources for campus internationalization and increased attention to issues of access and success for aboriginal students. Named both a "top lobbyist" in Ottawa and a "top foreign policy influencer," prior to joining Universities Canada, Mr. Davidson was the executive director of World University Service of Canada (WUSC) a leading international development agency active across Canada overseas. Mr. Davidson also held senior positions in Canadian book publishing and led the Toronto office of a prominent government relations firm. Mr. Davidson holds an MA from Queen's University and a BA from Trent University.

Introductory Comments by Co-Chair Mr. Paul Davidson

I am Mr. Paul Davidson president of Universities Canada. I would also like to acknowledge Aubie and his leadership over the last couple of days. I would also like to acknowledge that were meeting on traditional territory of indigenous people that have been gathering here for centuries in particularly the Anishinaabe and the Algonquin peoples of this area. I'm also reflecting on the venue a bit this morning. The session we held two years ago was in the basement in a windowless room and there was a feeling that we were under siege because people had been pounding the community for decade about the value of higher education; about the value of research; and whether the investments were generating the results we needed and where on earth or what on earth would our graduate students be doing.

Well the tone has changed, and I think one of the great things that has happened over the past couple of years is that we now have evidence to support the stories that we have been telling for years. We have a very ambitious agenda this morning with a terrific Keynote Speaker who will be introduced in a moment, six roundtable speakers and two discussants. We will give each speaker just a few short minutes to intervene and then have a lively conversation.

Given the time constraints I'm going to ask everyone around the table to be both provocative and concise in their comments and of course our aim is to explore the future of graduate education in Canada.

I've said this in a couple of occasions but I think I have one of the best jobs in the country because I am on the road 100 days a year visiting campuses across the country. It gives me great hope for the future of Canada. 1 million students are pursuing their first degree. The experiences they have, and the experience that graduate students have, will shape the Canada we want for the next 50 years. So what is it that we want to equip these students to be able achieve?

I would also add that in the course of these visits over the 100 days a year I can see this community aligned in a way we haven't seen in a very long time. I'm of course speaking about the Naylor report and its references to the importance of investing in talent, and making sure that Canada has the talent it needs, not only for the academic community but for the economy and for society. If you have not seen it I will just flag a comprehensive set of polling data that Universities Canada produced over the summer. We last did a poll like this in the summer of 2015 in anticipation of the federal election. It is very interesting to see what's changed in the past two years. This is available on our website. One of the most important things that has changed, unprecedented in the experience of Bruce Anderson, is people's confidence in young people to see Canada through the challenges we face. It is up 9 points in two years. That's a real shift in public opinion, and we have to capture that wave. People are confident in the abilities of Canadians, young Canadians particularly.

Another thing we have seen in the last couple of years is interesting investment decisions being made by global corporations and you know they are not choosing Canada because of the tax breaks. They are choosing Canada because of the Talent. When Reuters relocated its Global headquarters to Toronto it was because of the talent. When GM reinvested in Oshawa it was because of the Talent. They explicitly cited five universities within x hundred kilometres of GM. Or when ABB invested 90 million dollars in Montreal it was because of the Talent. These are important messages that we share and we are in a new moment for Graduate Education and for the work that we are doing. One of the things I am

most pleased about since we gathered two years ago is that we have evidence, and in that connection we are looking forward to hearing Dr. Reinhart's presentation.

I will close by flagging one other recent development which some of you may have seen and the Globe and Mail reported on its front page last week. Canada's university presidents have committed to seven principles on inclusive excellence, and this is explicitly recognizing that we need our academy to more accurately reflect Canadian diversity. You cannot have excellence unless you have inclusion. So not only are there seven excellence principles but there is an accompanying action plan, you will be seeing us roll that out in weeks, months and years ahead.

I'm going to turn it back to Ruth to introduce Dr. Reinhart Reithmeier.

Massey College, University of Toronto

Home of F.C.I.H.R.

Roundtable

"The Future of Graduate Education in Canada: New Directions".

Keynote Addess: "10,000 PhDs Project: Implications for Graduate Education".

Dr. Reinhart Reithmeier

Dr. Reinhart Reithmeier, PhD, FCAH
Special Advisor to Dean of Graduate Studies, University of Toronto.

Dr. Reithmeier is known internationally for his research on anion transport membrane proteins in human health and disease. An award-winning lecturer and graduate mentor, Dr. Reithmeier enjoys teaching introductory biochemistry to over 1,000 undergraduate students every year, as well as upper level and graduate courses. As former Chair of Biochemistry and a Special Advisor to the Dean of Graduate Studies on Graduate Skills Development and Engagement, Dr. Reithmeier is dedicated to ensuring that graduate students have the skill set and network to succeed in graduate school and be fully prepared to take advantage of the diverse job opportunities available to them in today's global marketplace. His leadership was recognized in 2012 by election to the Canadian Academy of Health Sciences.

The Future of Graduate Education in Canada
"10,000 PhDs Project: Implications for Graduate Education".

Abstract

Graduate education in the health sciences has traditionally focused on creating the next generation of researchers and scholars, both at the MSc and PhD levels. Canada is generally very effective in producing such well-educated scientists. The Friends of CIHR have had an increasing focus over the last two years on early career investigators, and on the processes and results of PhD preparation in Canada. A key question arises - where do the increasing numbers of PhDs being produced in Canada and around the world end up professionally? The School of Graduate Studies at the University of Toronto (U of T) launched the 10,000 PhDs Project to determine the subsequent (2016) employment status of the 10,886 individuals who graduated from U of T in all disciplines between 2000 and 2015. Follow-up had an 85% success rate. The outcome data showed that overall, about 30% of PhDs from this cohort are currently employed as tenure-track professors. The majority find employment within academia, yet increasingly, PhDs are pursuing non-academic opportunities in the private, public and charitable sectors. In the life sciences, 18% of PhDs are employed as tenure-track professors and an additional 7% as adjunct professors, mainly working in affiliated hospital research institutes. An increasing number of PhDs are working in the private (biotech and pharma) and public (government and hospitals) sectors. Many universities have recognized the need to provide graduate students with an enhanced and diversified skill sets to allow them to take advantage of the career opportunities available to them in academia and beyond. The challenge is to integrate these essential skills into graduate education without compromising the research quality and the whole enterprise which depends heavily on superb trainees, recognizing that the majority of them will not become independent researchers in the traditional sense. What new opportunities does this situation represent, for the trainees, for the mentors and for all sectors in our highly educated, more and more technology-engaged society?

“10,000 PhDs Project: Implications for Graduate Education”.

It is a great pleasure to be here and I thank Aubie Angel and the Friends of CIHR for this kind invitation. One of the reasons that I would like to present the results of the 10,000 PhDs Project to this august group is to get some feedback. Everyone sees data through a different lens. What are the next steps, especially the implications for the future of graduate education.

So what is the10 000 PhDs project? It’s an initiative of the School of Graduate Studies at the University of Toronto (U of T) to determine the current employment positions of the 10,886 PhDs in all disciplines who graduated from U of T from the years 2000 to 2015. We went back to 2000 to see if there have been changes over this time period. We hired a team of media savvy undergraduates to troll the internet to search publically-available sources such as official university and company web-sites to locate people and as you will see we found 85% of the graduates. It took about seven months of work and the budget was $50,000. At $5 per person I think it’s an extremely affordable kind of project to do.

There has been new investment in graduate education in Ontario and across the country. PhD graduate numbers from 2000 to 2015 so we have gone from 494 to 901, an almost doubling in the number of PhDs that U of T produces. U of T has four graduate divisions: Physical Sciences, Life Sciences, Social Sciences and Humanities. The biggest growth has been in Physical Sciences from about 100 to 290, almost a tripling of the number of PhD graduates. Life Sciences more than doubled and Social Sciences had about a 50% increase, Humanities is absolutely flat; about 100 people graduating in 2000 and 100 graduating in 2015.

Using only internet searches we found 85% percent of the graduates; 15% are classified as unknown. About half the people work in the post- secondary education sector (PSE), 26% as tenure-track professors in Canada and around the world. The private sector is 18%, the public sector about 10%, and the charitable sector 3%. The number of our graduates who are currently tenure-track professors has stayed constant at about 200 per graduation year. It drops in more recent years because of the number of people doing post-doctoral fellowships, a necessary pre-requisite for faculty positions in Life and Physical Sciences.

Beyond tenure-track professors in PSE are adjunct/status-only professors (~ 3.4%). Most are life-science graduates who are working in fully-affiliated hospital research institutes. We also have full-time lecturers and teaching stream professors (2.3%), bringing the total percentage of PhD graduates currently working as professors to over 30%. Part-time lecturers is a pretty big sector (3.6%); mostly humanities graduates who are doing sessional teaching. A question to be addressed is: do these people eventually move into full-time employment, or do they want to be part-time? I think that should be looked at very carefully. If you look around the university there are lots of PhDs working in high-level administrative positions in research offices, in ethics offices, in compliance offices, in grant-writing offices. Some PhDs are employed as research associates working in labs or running research facilities. About 7%, mostly recent graduates, are continuing their education as post-doctoral fellows with a small number (1%) in professional schools.

So, what about employment in the private sector? A bit a surprise to me was the number of PhD graduates working in the banking, finance and investment sector, mostly computing science, physical science, math and physics PhD graduates. The biggest private sector employer is Biotechnology/Pharmaceuticals, mostly Life Sciences graduates. So, one message is that our graduates are not only working in post-secondary education sector but half of them are working in these other sectors. Then if you look at the Public Sector graduates are finding employment in government and hospitals; hospitals employing mostly Life and Social Sciences graduates.

So, where do PhD graduates they work? Of the 9,243 people we found, 2/3 of them are currently employed in Canada, about 21% are employed in the US and 13% elsewhere. These numbers here do include post-doctoral fellows. It's very common for our graduates to go elsewhere to train and often we recapture them and they come back to Canada. We broke the data into Canadian citizens, permanent residents, international graduate students. Most Canadian citizens are employed in Canada, some are employed in the United States. A little over half of Permanent Residents and about a quarter of international students stay in Canada. Some 70% of Americans get jobs back home, 20% stay in Canada and the rest go elsewhere. For Chinese citizens we found its about equal number stay in Canada, go the United States or to their home country. Permanent Residents and international students who stay in Canada help increase our diversity and represent a "brain gain" for our country, highlighting the importance of recruiting top talent internationally.

In terms of tenure track professors, U of T PhDs populate 64 universities across Canada. U of T is the highest employing 256 of our graduates. That is not to say that U of T only hires its own graduates – the 256 represents about 15% of our total hires over this period. Second is York and Ryerson is third. This tells us that U of T PhD graduates tend to stay in the GTA for whatever reason. PhD graduates are also employed as tenure-track professors in United States. A lot of them are Americans of course but do include Canadians. When we looked internationally where PhD graduates are employed we see universities in Singapore, Hong Kong, and China. These are mostly citizens of those countries who return to their home country. So again, we are populating universities across Canada, in the United States, and internationally with our graduates.

Gender always an important issue. 49% of PhD graduates are female and 51% male. You wouldn't be surprised to learn that in the Physical Sciences it is male dominated, and in the Life and Social Sciences there are more women. Some disciplines like mathematics are very male dominated while some like nursing and speech language pathology are female dominated. But in most graduate units the gender distribution is about 50% plus or minus 10%. Of the PhD graduates who have tenure-stream positions the distribution is 54% male and 46% female while teaching stream professor positions tend to be female dominated. If you look at the part-time sessional again it tends to be common in the Humanities and mostly women. Again, if you drill down to departments those numbers would change pretty dramatically.

In Life Sciences 18% of PhD graduates are currently tenure-track professors. An additional 7% appointed as adjunct professors are employed in university-affiliated hospital Research institutes. 10% are currently employed as post-docs, mostly recent graduates. Some (3%) go into professional schools, mostly medical or dental. 17.5% are working in the private sector, mostly in bio-tech/pharmaceuticals in the GTA.

We have had a dramatic increase in the number of graduates in the Physical and Life Sciences and the number assuming tenure-track positions has remained absolutely constant. So, where are all of these graduates employed? Largely in the Private Sector. One of the strategies of the Ontario government to develop an innovation economy was to increase graduate enrollment. This has led to increased number of graduates who increasingly are finding employment in the Private and other Sectors. The data for PhD graduates from the Faculty of Medicine is very similar to Life Sciences with about 15% of PhDs assuming tenure-track positions and most working within the Private Sector in the Biotech/Pharmaceutical industry.

Findings and Implications

So, faculty positions are limited and non-academic careers are in the majority.

The good news is that PhD graduates have found employment in other sectors. But, there is a need for graduate professional development. Graduate students need to develop a strong professional network outside of academia and they need the support of their supervisor to consider diverse career choices beyond the goal of a traditional tenure-track position. We are creating the next generation of researchers, but also the next generation of thinkers. And those thinkers are going into different sectors and if you look at their job titles they have leadership roles. These sectors want those people because they have these highly-evolved skills. We also have an international brain gain. We know the value of the PhD in academia. The private and public sectors are seeing the real value in the PhD as well. So that's something we have to work on, promoting the value of the PhD in academia and beyond academia.

Thank you very much for this opportunity.

1. This presentation is a summary of a 10,000 PhDs Project Report submitted to Joshua Barker, the Dean of SGS at U of T. The author and team members wish to thank Locke Rowe, former Dean of SGS (2014-17), for his support of this initiative and Linda Jonkers from HEQCO for advice on data collection. This research project was carried out by: Reinhart A.F. Reithmeier (Project Leader); Liam O'Leary (Research Coordinator); Corey Dales (IT Support and Data Integrity); Abokor Abdulkarim, Lochin Brouillard, Samantha Chang, Samantha Miller, Wenyangzi (Ann) Shi, Nancy Vu, Xiaoyue (Grace) Zhu, Chang Zou (Research Assistants) with financial support provided by SGS

Another Voice: If I can add to that it's also come with the scholarships and awards that they self-select in so far as it can't be an international student unless they happen to be a Vanier and from the data that you have shown and other data that we see from HEQCO and some sources it's clear that these international students are a huge gain for Canada and the economy. And we have got to revisit that.

Dr. Reinhart Reithmeier: So, I didn't show that data but in 2000 10% of our graduates were international and in 2015 it was 15%. So, we know it's gone up but is that right number? Should that be higher?

Dr. Jim Woodgett: Another point about studentships and fellowships is that there is an incumbent advantage so often if somebody gets a studentship, they get a fellowship and I think it works against diversity and inclusion. Because often these are kids who are privileged and we know that with the summer student programs selection. I think it's good to have those programs but they should be limited.

Dr. Anne Martin-Matthews: I have a question related to the data, given that this is just a snapshot in time, I'm interested in knowing whether these trainees had thought of where they were headed or whether their current position was just a default option? Something like this would really play into their levels of satisfaction with their positions. Did you ask them much about their aspirations?

Dr. Reinhart Reithmeier: So, we didn't contact anybody in this project. That's the next phase. We have given all the data to each graduate unit and recommended that they reach out to their graduates to tell their stories. I know in the Faculty of Medicine we did surveys in the departments and students who enter the PhD program and it's about 75% that want to become tenure-track professors. The output is 15% so that's a sharp learning curve in 5 years over a graduate program going from 75% to 15%. So, how do those people select, self-select or we select them and they end up in crisis. I've talk to many post-docs who say oh my dreams of getting an academic position are over. Its competitive, and with double the number of graduates, more competitive than ever. We are looking globally for the best talent so you have to be globally competitive, being competitive in Canada is not good enough. That's the reality check I think having this data will have for incoming grad students into programs and saying well this is my reality I still want to go for it. The percentage of PhDs that are currently tenure track professors varied incredibly with the graduate program. So, the number one program where graduates are currently working tenure-track professors is the Rotman Business School. If you do a PhD in business not an MBA you want to be an academic. It's a growing academic discipline they are looking for professors. 75% of their PhDs become tenure-track professors. Number two is N with ursing 50% of the PhDs who graduate from the Faculty of Nursing at U of T assuming tenure-track postions. Third is Kinesiology, 40 % of PhDs in Kinesiology are currently tenure-track professors. So if you have a kid who wants to become a professor tell them to do a PhD in Business , Nursing or Gym! Fro biochemistry is 14% and Immunology 9%. So that's the next thing is to do the kind of story-telling.

Another Voice: Its particularly interesting because at business school if you have a PhD or an MBA from a Business school you can make a lot more money private sector than you could as a prof at a business school, and yet it's the highest percentage of people who go back to be an academic.

Another Voice: Maybe they are disappointed they had to take a tenure-track!

Dr. Reithmeier: So, again thinking about new emerging academic disciplines we need to develop graduate programs in those to populate them with highly qualified professors.

Roundtable

"The Future of Graduate Education in Canada: New Directions".

Speaker

Dr. Brenda Brouwer

Dr. Brenda Brouwer, PhD
Vice Provost and Dean, School of Graduate Studies

Professor, School of Rehabilitation Therapy and the Centre for Neuroscience Studies, Queen's University, President, Canadian Association for Graduate Studies (CAGS)

Dr. Brouwer is a professor at Queen's University where she maintains a research program quantifying the biomechanical, neuromuscular and metabolic demands of mobility in which she has supervised over 34 research Master's and doctoral students. As Vice-Provost and Dean, Dr. Brouwer promotes and supports the graduate mission providing both academic and administrative leadership. The expansion of graduate credentials, enrolment management, maintenance of high academic standards, and the establishment of policies and best practices that support graduate students academically, professionally and personally are part of her portfolio. As president of CAGS, Dr. Brouwer works to support the mission of strengthening graduate education through reform, advocacy, national dialog and actions to ensure that policy makers, politicians and the public realize the value of graduate education in promoting societal well-being and advancing creativity, technology and innovation.

Driving Change in Graduate Education

I'm going to talk about the factors that are Driving Change in terms of how we train PhD students. We all recognize that the PhD represents a significant milestone of achievement as it is the highest academic credential reflecting perseverance, deep understanding, original research and scholarship. This has been the case for many decades and should not change. What has evolved is the value proposition of the formative process of training doctoral students. There is a convergence of factors that are driving the need for change; the foot is on the accelerator and standing still is not an option. There are three main factors to consider. One is a growing interest in leveraging knowledge and mobilizing research among government, industry, public and private sectors as well as the tax-paying public that supports our institutions and the research we do. This serves to increase the demand for PhD graduates to enhance productivity, global competitiveness, and foster societal well-being and innovation. Another is the acknowledgement that PhD graduates go on to successful careers spanning all sectors, which is pushing universities to rethink the formation of graduate student researchers and scholars to prepare them to translate and apply their academic training and skills beyond the academy and equip them with the skills and competencies for a highly skilled workforce. Finally, today's students have different aspirations, goals, values and expectations of the graduate experience that calls for student-centric approaches to pedagogy including the structure or format of major requirements (e.g. comprehensive examinations and the dissertation). It is imperative that we align how we train PhDs with student needs as well as the economic and labour market realities to ensure the formation of talented, highly skilled graduates who can adapt and thrive in rapidly transforming employment and global

landscapes. Importantly, both academic and professional development must be core to the curriculum. So how do we change the training environment? We could dispel antiquated notions about the PhD being an apprenticeship for the professoriate and the decidedly insular approach that demands independent research that should be packaged in a way suitable for academic consumption. Our students must be encouraged to venture beyond what may be described as a gated academic community. Sharing their research with a variety of audiences not only educates the public but also maximizes its reach in promoting uptake of ideas and sparking innovation beyond the discipline.

Take the three-minute thesis as an example. More than 75% of Canadian graduate degree granting institutions held competitions in which students communicate the key messages of their research to engage audiences in their community. These events garner media attention, contribute to public discourse and build strong public relations. The model is increasingly finding its way into PhD curricular requirements for its instructive value in effective communication that transcends the academy.

A national conversation about comprehensive exams and the structure of the dissertation has led to local changes in policy and practice that enable greater scope and format options that engage various stakeholders and embed practical and applied learning opportunities. Changing the culture of the academy to incorporate different ways of knowing, to facilitate access and uptake by groups outside the academy who stand to benefit, and to accept that there may be more effective (and even desirable) means of dissemination than the academic journal is part of the evolution of the PhD. Why not a white paper, a position paper, a syllabus, a popular article to reach broader audiences and better align with students' career aspirations? These scholarly outputs could be part of the thesis as well as a valuable reflective document in a student's portfolio that may have direct relevance when navigating the job market. Similarly, including non-academic stakeholders on advisory and examining committees can enrich the learning experience and make important connections that can incubate new applications or directions for the research.

Many of the complex issues facing today's societies require interdisciplinary perspectives, approaches and understanding. Granting agencies intentionally fund teams that bring together complementary skills and knowledge to address the problem. In contrast, we rarely mentor our PhD students to work in teams and collaborate outside of their disciplinary silo - it's part of the tenet that PhDs must develop as independent researchers. What we absolutely need is independent thinkers who can contribute to advance ideas in collaboration with others. Training students to work effectively in teams aids in understanding the value of their contribution in the wider context and leads to creative and innovative solutions to multi-dimensional problems. Portions of the thesis could be co-authored by students with appropriate attribution and description of their respective contributions. Such experience would address the employers' lament that PhD graduates lack team experience and it would also reduce the isolation that PhD students often report with respect to their research.

Finally, opportunities for work-integrated experiences where PhDs can apply their research knowledge and skills in non-academic settings can yield tremendous benefit. As demonstrated by Mitacs, these experiences create jobs, catalyze product and policy development, lead to social innovations that benefit companies, organizations, and communities. When integrated into their training, students reflect on their experience and are able to consider the broader implications of their research and appreciate the transferability of their training and skills.

There is incredible latitude to reconfigure the training environment such that PhD students can share their work more broadly, form networks, research collaborations, and gain experience in mobilizing their knowledge and skills beyond their discipline and the academy. I'm not advocating that we abandon the old model, but rather that we modernize it to incorporate options that align with current student goals, societal needs, economic realities and still produce high-quality, impactful research and scholarship.

Graduate education must advance into the 21st century - it's a matter of relevance, value and well-being.

Grant Hall Queens University

Kingston Ontario

Roundtable

"The Future of Graduate Education in Canada: New Directions".

Speaker

Dr. Ed Kroeger

Dr. Ed Kroeger, PhD
Chair Canadian Student Health Research Forum, Max Rady College of Medicine, U Manitoba

Ed Kroeger is a Professor of Physiology and Pathophysiology at the University of Manitoba. Within the context of his portfolio as Assistant Dean for Graduate Studies (in Medicine), he recognized the need for networking top Canadian PhD trainees in the health sciences nationally. In pursuing that goal he founded, in collaboration with the AFMC Standing Committee for Research and Graduate Studies and the CIHR, the Canadian Student Health Research Forum (CSHRF). He is also the AFMC representative to ORPHEUS and has forged international linkages for our students through an academic partnership of the CSHRF with the Lindau Nobel laureate meetings.

Thank you Dr. Angel for inviting me to participate in this forum and thank you Dr. Reithmeier for your most timely report and address.

I'm speaking from my perspective of many years as an assistant dean for grad studies in Medicine and having co-ordinated the development of the Canadian Student Health Research Forum (which I will refer to simply as "the Forum"). The Forum now attracts top 5% PhD students nationally for networking, showcasing, and recognizing their excellence.

First of all I agree with you Dr. Reithmeier - the one-size-fits-all approach that we have adopted in graduate research training and education does not serve any of our interests or our stakeholders well. In promoting change I have been stymied by the structurally embedded conflicts of interest: 1) In our hyper-competitive environment PIs require productivity to maintain grants and career trajectories, so the pressure is on students to stay at the bench rather than taking courses and teaching workshops on career development, or even English proficiency. 2) Granting agencies require efficiency in their resource utilization with students providing cheap labour. 3) Institutions need grad students' tuition fees and all of these perspectives conspire to engage young researchers at minimal cost and with minimal attention to their interests regarding career development. And I agree with you Dr. Reithmeier regarding both your diagnosis and treatment plan which should, I believe, include the national granting agencies in effecting the needed cultural shift.

My plea though, is that we not forget the foundation of excellence - the underpinnings upon which the whole enterprise is built and that we commit to addressing the entire spectrum of trainee needs. These must include the needs of those who will be the thought-leaders in research, those who will lead the funding agencies and guide government policy, become laureates of the Nobel and Gairdner

foundations, those who will provide the leadership edge to the whole research enterprise. In a word, I believe that our top achievers need to be networked broadly if their careers are to be optimized. I am pleased to see the word “network” on the cover of your report Dr. Reithmeier. It takes on a particular importance for students in the area of health research, as a fact of life for grad students in the health professional faculties is that their life is cloistered in the lab setting. Their courses have small enrolment, their faculty-based decanal leadership is focused on professional students and thus our grad students feel invisible, alone, under-appreciated and/or understood. Even the term graduate education is frequently mistaken for post-graduate medical education in medicine. When I recognize these facts in speaking to our graduate students the air pressure seems to rise a few millibars as the audience exhales and there is an audible response of relief that their situation and needs are being voiced.

There are several facets of networking that I would like to highlight:

First, there’s the obvious - networking with their peers of excellence in the health sciences broadly. While this may seem obvious, given the breadth of collaborations often needed to connect the concept-dots, students are too often contained and constrained by program requirements within their departments. As Dr. Bernstein has noted, departments do not intrinsically promote broad collaboration. In identifying CIHR institutes whose mandates are relevant to their science, attendees of our Forum frequently identify two or even three CIHR institutes. So the need for students to rub shoulders with creative students across the spectrum of CIHR interests has become increasingly important and evident. And thank you, Dr. Bernstein, for your encouragement on this point.

A second facet is the networking of our elite research trainees with funding agencies and accessing their resources for career development. The national funding agencies have terrific reservoirs of information and experience that would be invaluable to our most promising young research trainees. Finding a venue such as the Forum in which there is an interface between CIHR, for example and the trainees who are likely to become their star researchers is clearly in the interest of both the agencies, the trainees and institutions. I should note that the CIHR career development workshop at our Forum is most appreciated by the students.

A third facet of opportunity, in which Canada has a distinct advantage, is the opportunity for networking our top students with internationally respected role models - Gairdner laureates. We have in Canada an organization that celebrates Nobel-class excellence and has within its goals the in-person communication of their laureates’ excellence and experience - paying it forward to the next generation of researchers. This represents a unique opportunity for strategic mentoring. The confluence of CIHR-, Gairdner- and trainee interests is clear and celebrated at the Forum (and I think this model could be replicated broadly).

Fourth, we need to network our trainees with Canada’s state-of-the-world research laboratories - I refer to the facilities such as the National Microbiology Laboratory in Winnipeg. The benefits to research and training within their respective locales are evident, but we do not have an active and accessible outreach program (to invite external students for short-term training experience that could have important implications for their career trajectories).

Finally I would submit that the estimated 30 000 health graduate students in Canada, with their unique opportunities, culture, environment and challenges deserve to be networked through a Canadian health sciences graduate students association, with representation to CIHR, the Association of Faculties of Medicine of Canada and other relevant stakeholders.

In sum, within the context of Dr. Bernstein's observation that today's students are entrepreneurial, interdisciplinary and collaborative I would recommend that we prioritize national leadership toward networking our grad students generally, and the elite students strategically, for the benefit of our core enterprise.

Mr. Paul Davidson: Terrific thank you very much Ed.

Prarie Crocus, The Flower of Manitoba

Roundtable

"The Future of Graduate Education in Canada: New Directions".

Speaker

Dr. Martha Crago

Dr. Martha Crago, PhD
Vice-Principal (Research and Innovation), McGill

Prof. Crago was previously the Vice-President Research and Professor in Human Communication Disorders at Dalhousie University. Her previous university administrative positions include Vice-President of International and Governmental Relations at the Université de Montreal as well as the Dean of Graduate and Postdoctoral Studies and Associate Provost (Academic Programs), both at McGill University.

Martha Crago is the Chair of the Research Committee of the U15 group of Canada's research intense universities. Previously she was President of the Canadian Association of Graduate Studies,a member of the American Association of Universities Deans of Graduate Studies' group, the Universitas 21's Research Directors and Graduate Studies Group and the Board of the US Council of Graduate Schools. In 2016 she was selected by the Minister of Science of Canada to be a member of an Advisory Panel on the Funding of Fundamental Research and as an External Expert for the National Research Council Dialogue.

Prof. Crago has been an active researcher in language acquisition across a variety of languages and learners, including monolingual and bilingual Indigenous children learning Inuktitut, Cree, Mohawk, Algonquin, as well as children learning English, French and Arabic. Her work has been published

Disrupting Graduate Studies

I come at graduate studies from a different angle. I am a social science researcher who spent most of my career in the Faculty of Medicine at McGill. I also have had the privilege of working and doing a lot of my own research in indigenous communities of Canada. As we think about all the people with their PhDs from the University of Toronto who are going to work in the pharmaceutical industries, I want us also to think about indigenous students. I supervised the first thesis written in Inuktitut at my university and perhaps in Canada. It was a Masters level thesis. The thesis committee had on it Inuit elders, Inuit educators and some non-Inuit people. Compare that to the Inuk woman who said to me after she read my own thesis "Your people like to say everything in words we don't, we aren't like that." There are various different ways of knowing, different ways of expressing oneself. We need to think about them when we educate indigenous graduate students. There is attention being paid these days to indigenous ways of knowing and to indigenous forms of research. It will be interesting and important to shift our paradigms and make sense of what Indigenous ways of knowing are, how they have they evolved, and how they intersect with our more customary doctoral theses.

Furthermore, once when I was at the University of Alaska, I discovered that indigenous students had to write an academic paper and then take that academic content and turn it into a document to share with

their home community as well as a document showing how they would argue the content at a negotiating table. Graduate students of all kinds can and should develop a range of genres of writing and speaking. Frankly so should those of us who speak to various audiences. Recently I have been attempting to speak persuasively to people in government about the Naylor report. This, if you will, is equivalent to my negotiating table. Yet. I am not sure I am as persuasive a communicator as I could have been if I had done the same exercise that the Alaskan Indigenous students had to do.

If we take this further, why couldn't we include a newspaper article or an op-ed as part of a thesis? What about a radio or television broadcast related to it? What about a thesis that is electronic with links to, for example, embedded videos. For my own research, I spent a lot of time in Indigenous homes. This resulted in many hours of video that these days I could or even should have embedded into sections of into my thesis. I also remember permitting the first completely electronic thesis at McGill that had hyper links in it and I had to decide what to do about the fact that hyper-links can be very transient. A thesis can and should be seen as an evolving phenomenon that has new and different formats rather than as a format that is for all times.

We have evolved by incorporating students' research experiences in industry as a part of their graduate studies. But are we preparing them well enough for careers in industry? Do they know about how industries function and are structured? Do they understand the governance and hierarchies of industry? Are those changing in a rapidly changing world of disruptive technologies and start up companies?

In addition, some of our students will end up working in the context of big science projects that are not for profit corporation. It will be useful for them to learn more about not-for-profit corporate structure and governance as well as the structures and governance of the private sector.

Much is made of the mental health crises on campuses these days. We need to make sure our graduate students are better prepared to take risks and to be resilient and tenacious. Perhaps, we need seminars on how to handle failure that will help graduate students see that we all hit various walls and need to regroup and re-position ourselves. Alongside of that, our graduate students should be mentored to have vision and think strategically. We need to raise questions like: How is your research positioned strategically? Where are you going to go with your career? What is your vision of your own future and that of your research? How will you help to create that future? We also need workshops for their graduate supervisors in which they too learn to talk about resilience, tenacity, vision, leadership and change. These are the very capacities in which Alan Bernstein excells and we need more Canadians with his strategic vision and leadership.

A final commentary on the University of Toronto study. It revealed to me that Canada has become just what people in our country have been talking about for the last several years. We have become a knowledge economy. Of course, we still have more steps to take. For instance, in Germany, CEOs in companies like Siemens almost all have PhDs. This is a very different than in North America and it provides an interesting lesson for us. The receptor and proactive capacity for conducting research in a business sector is enhanced if the people leading the companies in that sector have research backgrounds.

In summary, there is a wonderful and somewhat disruptive world of graduate studies where we could educate quite different people in a number of different ways - if we use our vision to imagine it and our leadership to risk putting it into action.

Roundtable

"The Future of Graduate Education in Canada: New Directions".

Speaker

Dr. Anne Martin-Matthews

Dr. Anne Martin-Matthews, PhD, FCAHS
Acting Vice-President, Research, Knowledge Translation and Ethics
Canadian Institutes of Health Research (CIHR)

Dr. Anne Martin-Matthews is Acting Vice-President, Research, Knowledge Translation and Ethics at CIHR, as of May 2017. She was Scientific Director of CIHR's Institute of Aging (2004-2011), leading the development of the Canadian Longitudinal Study on Aging.

She is Professor of Sociology at the University of British Columbia, and a Fellow of the U.S. Gerontological Society of America, and of the Canadian Academy of Health Sciences. Her research focuses on issues of aging, health and society. She established the CIHR Institute of Aging's annual Summer Program in Aging, and co-founded an International Summer School in Aging with colleagues in Italy and Sweden. In 2012, CIHR recognized her commitment to graduate mentoring, creating the "Anne Martin-Matthews Doctoral Research Prize of Excellence in Research on Aging." In 2016, she received the Canadian Association on Gerontology's Shapiro Recognition Award for Excellence in Student Mentoring. In 2018 Dr. Anne Martin-Matthews was appointed an Officer of the Order of Canada.

Dr. Martin-Matthews holds a BA (Memorial), PhD (McMaster) and an Honorary Degree in Civil Law from Newcastle University (UK).

Positioning Trainees for Success Within and Beyond the Health Research Enterprise

Thank you for this opportunity to provide the Canadian Institutes of Health Research (CIHR)'s perspective on new directions for the future of graduate education in Canada.

I would like to begin by stating that CIHR is fully committed to training and mentoring the next generation of researchers; as am I, personally. As many of you are aware, I returned to CIHR in May 2017 in an 'Acting' capacity, and am presenting to you today as the Acting Vice-President of Research, Knowledge Translation and Ethics at CIHR. However, my relationship with CIHR dates back to my days (2004-2011) as the former Scientific Director of the CIHR Institute of Aging. It was during my tenure as Scientific Director that I inaugurated the CIHR Summer Program in Aging, which provides cross-disciplinary training and networking opportunities for graduate student trainees in all fields of research on health and aging.

Health research training is a core priority for CIHR. CIHR recognizes that these types of investments contribute to the development of highly qualified personnel, and to the strengthening of the health research enterprise and the Canadian economy. For context: in the last 10 years CIHR has invested approximately $1.7 billion dollars (upwards of 18% of its budget) to support masters, doctoral, and post-doctoral trainees, either directly through awards or indirectly through grant funding. In addition, it

is important to recognize that CIHR is committing 4.6% of its budget to Indigenous Health Research; we know that building research training capacity is an especially important element amongst this research community.

However, CIHR also recognizes that, more and more, trainees are functioning in a changing research environment. We need to increase capacity in critical areas, such as: data-intensive research, the research capacity of health professionals, Indigenous health research, patient-oriented research, and entrepreneurship and innovation.

Features of the current research environment also present trainees with new challenges. Firstly, the health research landscape is evolving. It is becoming increasingly interdisciplinary, globally connected, fast-paced, highly competitive, and is being revolutionized by the vast advances in technology. In addition, trainee career paths are changing, with the majority of health research trainees moving into careers outside of academia.

Therefore, it is clear that we must broaden our vision of research training to ensure that trainees are equipped with the skills necessary for the 21st century marketplace. As we collectively take on this challenge, there are essential steps required for success. First, we must clarify the skills required by that marketplace, then raise awareness of the skills that are needed, and then we must create an enabling environment in which trainees seek out and develop these skills.

To help clarify the skills required by the marketplace, CIHR conducted an environmental scan and held stakeholder consultations, which revealed variations in what are considered “essential skills”. For example, the OECD Workforce Skills and Innovation Report emphasizes professional skills that include: communication, information technology, team work, and problem solving; whereas the Canadian Council of Chief Executives emphasized other aspects, such as: people skills, relationship-building, and leadership skills. This raises several points for consideration, such as:

- How should we define and clarify our collective expectations of skills, for the benefit of trainees? and,

- Should we all be of the same mindset and encourage a common suite of “essential” skills?

These questions must be addressed, while remaining cognizant that skills vary across sectors, and therefore they should be broad enough to capture diverse career paths, but also remain adaptable to address the requirements of varied sub-disciplines.

Secondly, as part of CIHR’s Strategic Action Plan on Training, and in an effort to raise awareness of the skills needed in the marketplace, CIHR launched its revamped health research training website on October 17, 2017. The training website consolidates all health research related training information in one place, including: information on applying for training awards; access to new tools to help trainees via a “Career Hub”; a curated list of reports and studies related to training; and links to policies, strategies, news and events. Importantly, this website is a resource for careers within and outside of academia. CIHR has also taken several steps to ensure that trainees are aware of some of the essential skills that employers seek. A few examples of recent work on these issues, include: the development of an Individual Development Plan tool, which allows trainees and their supervisors to explore different career paths, establish goals, identify skills gaps and create an action plan to achieve them; and hosting and/or supporting career development workshops (for example, the CIHR Institute of Cancer Research’s upcoming session on finding careers outside of academia, to be held at the Canadian

Cancer Research Conference; and, as noted, the CIHR Institute of Aging's Summer Program in Aging). In addition, CIHR is providing access to a variety of training resources - including labour market reports - and training modules to help trainees develop their essential skills and to create awareness amongst trainees and supervisors around the professional expectations in different sectors.

Thirdly, we, as a collective, are working towards creating an enabling environment. In this particular element, academic institutions of course play a vital role in the essential skill development of trainees. However, CIHR recognizes that it does have a role in fostering system-wide and multi-disciplinary training as a funder. CIHR's position on training is grounded in evidence, using the findings from the evaluations of our training programs. These evaluations suggest that environments with a combination of research training and professional skills development opportunities result in positive research outcomes and career trajectories.

Some of the ways in which CIHR is contributing to such enabling environments includes building training and mentoring into CIHR funding requirements. For example, in CIHR's Foundation Grant program, stage two of the application includes a section on Training and Mentoring, which accounts for 20% of the total score. CIHR has also created opportunities for post-doctoral fellows to train as peer reviewers in award competitions. CIHR is partnering with MITACS to enhance access to workshops, internships, career tools, and business mentorship. CIHR also encourages the recognition of the leadership qualities of trainees through peer review. For example, the Tri-agency Vanier Scholarship program application requires the inclusion of a description of how applicants demonstrate leadership skills.

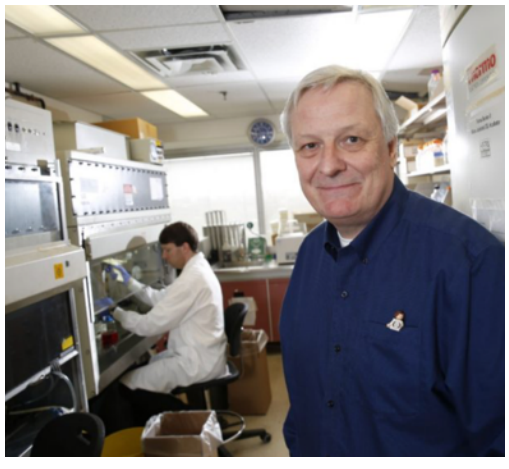
CIHR also provides trainees with experiential learning opportunities, to help them build and develop their diverse skills. In fact, the Minister of Health recently announced an investment of $5.8 million to support programs like the Health System Impact Fellowship, which provide trainees exposure to non-traditional training environments throughout the public, not-for-profit, private for-profit sectors at either the local, regional, provincial/territorial or national level. CIHR and the Tri-Council agencies are constantly reviewing and updating their award policies, to keep up with the current training climate, and to enable access to experiential learning opportunities during training. These are just a few examples of the work that, as a funder of health research training, CIHR is engaged in and advancing.

CIHR recognizes that it is only one of the many players involved in shaping the landscape and supporting the training of researchers. CIHR is committed to working with all members of Canada's health research training enterprise to continue to collectively build and empower the health research leaders of tomorrow.

Roundtable

"The Future of Graduate Education in Canada: New Directions".

Speaker



Dr. Jim Woodgett

Dr. Jim Woodgett, PhD, FRSC
Director of Research, Lunenfeld-Tanenbaum Research Institute,
Mount Sinai Hospital, Toronto.

Jim Woodgett is Director of Research at the Lunenfeld-Tanenbaum Research Institute (2005-) and runs a lab studying the molecular signals used by cells to determine cell fate and how these are subverted in diseases such as Alzheimers and cancer. He is also a passionate advocate for young scientists, diversity in science and a huge supporter of the Naylor Panel report on Fundamental Science.

Advantages and Disadvantages of Graduate Studies in a Hospital Research Institute Environment

Since we are talking about graduate studies I talked to some Graduate Students about topics to discuss today and I think it's a bit of a shame that they are not at the table, here, largely because they have very interesting perspectives… I am also going to talk about what I know, which is hospital-based research institutes and experiences of graduate studies within that sort of institution rather than the more common experience within a university. At the U of T there are 8 University of Toronto affiliated hospitals and each have research institutes. About 80 percent of bio-medical and health research is conducted within those research institutes in Toronto which represents a lot of funding. There are advantages and disadvantages to that sort of organization and there are variant models across different Canadian cities which provides healthy diversity. We have a series of natural experiments going on here and I think we should be encouraging that.

Indeed, there is no best solution to graduate education in the bio-sciences and I would argue that the diversity of experience which is available to the graduate students in Toronto is a significant advantage in terms of critical mass and fit. There is also an advantage to U of T. The university doesn't pay the hospital-based research scientists like myself. However, we pay the students and we also pay their tuition. U of T also receives the BIUs (seat funds) from the province; so whoever negotiated that on behalf of U of T should be working on our NAFTA team.

At LTRI, where I am Director of Research, we have about 130 grad students and about 140 post-docs. Our students are from multiple graduate departments at U of T. Each of the hospitals has a research training centre which looks after interests and concerns of the trainees. In part, this is because the supervisors don't necessarily do such a good job of this, as we are not in a student-centred environment like universities. These research training centres, as well as the graduate and post-doctoral organizations within each of the institutions, do a fantastic job. And they do so, I think, because they are very much trainee focused. The research institutes also largely have autonomy in terms of being able to directly apply for funding from CIHR and CFI (but not from NSERC and certain

other federal programs). So they actually act as micro-universities. Although not so micro because I think LTRI attracts about the same amount of research funding as SFU, for example.

So what are the advantages and disadvantages? To gauge this I talked to the students. They get to interact with students from different departments and, as a consequence, there is a lot more networking and two-way interactions which promotes interdisciplinary – it's natural to them. Academia is based on traditional disciplines and our universities are

working reduce departmental barriers. The institutes don't have such towers of Babel and the students are attracted to that open attitude. Our students earn a U of T degree - they graduate from the University of Toronto, which is very important to them. But they interact with very diverse environments because the U of T departments also cover multiple hospitals - so they also are immersed in interaction and collaborative opportunities. The student's supervisors tend to have lower teaching loads and more research time - which is important. Trainees in health sciences have observed that employers like the fact that they have been in a hospital environment. This is in part because they are actually hybrids, they are working in an environment which is not just about training, education and research. The main product of the hospital, of course, is delivery of healthcare. That's the number-one priority. So when they start their training, they don't get a trainee-focused introduction. Instead, they hear about things like patient privacy, vaccination, harassment at multiple levels, etc. You might think that they hate that, but they appreciate it as it provides broader perspectives.

Their PhD supervisors tend to not take sabbaticals, which maybe is both good and bad for the student. There is another advantage in greater subject depth. Universities must be broad in scope of experience since they must have teaching expertise for each discipline. What we find in a lot of research institutes is there are collections of deep, critical mass, such as a focus on neuroscience, some types of cancer or whatever. That is an advantage which works in fostering both depth and collaboration. There is also less scientific bureaucracy. Indeed, there is enormous fluidity because the researchers are evaluated almost solely on their research activity. Most scientists follow the funding to some degree but I think there is a level of mobility in research institute, which proves advantageous. Returning to teaching, if the supervisors do teach, they tend to teach graduate students, so the teaching load is lower than typically experienced by a university lecturer.

There are disadvantages of independent research institutes, too. For the students, their place of work is not a traditional campus. Departmental activities can take a lot of extra effort to attend and that's especially true for hospitals that are not located in proximity with the university. Students at these institutions may feel more isolated - though some may find that to be an advantage. In hospitals, there is a smaller body of students than at the University where they are the dominant entity. And while the supervisors may not teach as much, they also tend to travel more. Hence, student face-time with supervisors is not necessarily that different. Research associated with hospitals also tends to be more application-oriented and some of the students initially struggle with this. For students who find it difficult to adjust to working in a hospital, that may be because they are emerging from an undergraduate experience which is far more academically focused. However, they usually adapt well. There are other disadvantages to working within a clinical space. With the SARS outbreak in Toronto, several of the hospital research based institutes basically shut down. But that also acted as a reality check as well. There are also less Teaching Assistant opportunities which can add to financial hardship.

I think the system the diversity of the system having research institutes based in hospitals working very closely with an affiliated university can work very well because it encourages and improves diversity. Maximizing diversity of thought is the key element of research. That is the benefit of inclusion and diversity and equity: we need different minds that have developed from different backgrounds. So the more distinct experiences we can create the better - and hospitals doing things in different ways which helps that. I should stress that we also have a very good relationship with the university, despite the financial imbalance. I think that is partly because the research hospitals tend to be very competitive and enjoy some synergistic advantages over some other universities.

I'd like to end with a couple of provocative points. The following is not unique to the hospitals but students for many years have been taken for granted. They are a low-income, cheap labour force. They realize this and they are disaffected and they don't feel they have a voice. We have to recognize they have got choices about whether to enter graduate school or not. The "bargain" that we have with our students, that is valued training in exchange for work, need not necessarily be re-negotiated but we must be better aware of that bargain. In the research institutes, as I mentioned previously, we have more post-docs than students and the students are constantly exposed to post-docs. The latter are in a precarious state for the length of time they're in that role. The post-doctoral term has increased significantly over the past decade and, as Reinhart Reitmeier showed, the number of them going into academia has proportionally dropped even though the absolute numbers are the same. The graduate students see this and with it a reality check, which I think is to their benefit. What this means is that we should be looking at training in terms of the career lifecycle. This is also a point brought up by the Naylor Review on Fundamental Science - we need to change our idea of mentorship – a topic we haven't discussed. I think it was different 20 years ago when the expectations in my home department (medical biophysics) was that we were training the next generation of professors. A lot of professors, a lot of PhD supervisors, were brought up in that atmosphere and it is clearly an inappropriate attitude today. Most of our students and fellows don't necessarily want to go on to academia – and that is fine – as long as it we are supportive and help give them tools to succeed. We need, above all, to be careful about discouraging students by giving them the impression we are only interested in training the next generation of academics.

Dr. Reinhart Reithmeier: Actually about 75% say they want to become an academic.

Dr. Jim Woodgett: Absolutely, but I think the problem is in large part us. I also would argue that academic professors are not the best people to educate our students when we have the majority of those students going on to non-academic careers. Professors may be the best people for training for research and education, but we really need to be engaging and working to find better linkages and bridges with the private and public sectors. So that's another initiative that the research training centre at LTRI took on about 10 years ago. We have alumni coming in to talk to the students and post-docs: it's unbiased, it's direct and they have also gone through a similar experience so they know what the students are thinking because they were in their position a few years before. The most successful approaches are very much bottom up and I think we need to do a better job of asking students as to what we can do to improve their experience. They may say give me more experience or give me more opportunities to interact with people who are five years or ten years beyond me. The more we can do of that, the better.

Roundtable

"The Future of Graduate Education in Canada: New Directions".

Speaker

Dr. B. Mario Pinto

Dr. B. Mario Pinto, PhD, FRSC
President, NSERC

Dr. Pinto joined the Natural Sciences and Engineering Research Council of Canada (NSERC) as its President in November 2014. At NSERC, he augmented the agency's dual expertise as an investor in discovery-based research and a broker of successful R&D partnerships with technology-driven enterprises to de-risk promising research. A seamless discovery-innovation bidirectional continuum has resulted. Dr. Pinto champions global connectivity to increase the power of the line of sight by embracing diverse perspectives. He is also a champion of gender equity and inclusion of the two-spirit community in research and innovation. He was elected Chair of the Global Research Council in May 2017.

Graduate Education as Part of the Innovation and Skills Agenda

Thank you for the invitation, Aubie. It is indeed a pleasure to be here. Let me take this opportunity to present a slightly different view. You know for the past year at NSERC we have been scratching our heads as how to best make a value proposition that would resonate with our stakeholders and with government and result in significant investment in the enterprise in general. And we had this epiphany when we realized that our niche was in the skills development of the Innovation and Skills plan of the government. I know this is complex territory because it has been split up between two ministers: Minister Duncan dealing with science and Minister Bains dealing with the innovation and skills agenda. We have had to work very skillfully over the past year to try and bring those two aspects together. What do our clientele do when it comes to skills and talent development? It is the development of high-end skills. The development of critical and creative thought to respond to future challenges. That's it in a nutshell. So taking a good look at our data over a period of 40 years it became obvious to us that that is what we should be presenting and we have been doing so consistently and deliberately over the past few months. So just to give you an idea of what NSERC does, just NSERC not counting CIHR, we invest each year in 33,000 full time equivalent (FTE) students and post-doctoral fellows. Of those, 11,000 FTEs work on industrial problems. Of those, 1,500 work directly in industry. These 11, 000 are getting a very different experience.

They are being exposed to new ways of thinking, to team work, to communication and management modalities, being exposed to the real world. Mitacs is also in this space and we work very closely with Mitacs. We decided with Mitacs to extend our mutual runways. So we add Mitacs internships to our existing programs. This is a great accomplishment. And we make the case for each other both nationally and internationally. And I'll come back to that. So it is clear that we have a tremendous investment in people. When we did a forensic analysis of what happens with our discovery grants, we

found that 60% of all our discovery grant funds go to the support of highly qualified personnel. That's 60% of 353 Million in the last year. So it ain't peanuts as they say. We have therefore decided that this is what we are going to use as our baseline and I can tell you on everyone's behalf that we have been advocating a very simple message: Invest in high end skills. So can we do better? Of Course we can do better and Alan Bernstein has written on this in his last opinion piece and I agree with a lot of what Alan says. Not necessarily with the means to the end but certainly with many of the principles. I think we have to face facts and train students with greater communication skills, how to work in teams across disciplines, how to have an appreciation of cultural diversity, and Martha has given a wonderful example of this last aspect. And how we can build international networks for the future.

And therein lies the challenge and Alan has spoken very articulately about this. So let me tell you what we are doing, currently. And I will just use five programs as examples so we can get straight to my point. We have a CREATE program which brings together teams of students across disciplines spanning the country along a certain theme of research, for example, epigenetics or biodiversity. one brings together the best PIs from across the best labs together with their students and in some cases we have industrial partners. NSERC contributes $300,000 per year for 6 years. This program has an annual budget of 27 million and if I look at the active CREATE grants at the moment, there are 90; we have funded 17 new networks per year. Since 2009, we have trained 1,500 students in this programs. This was not an original initiative; we learned from CIHR from their strategic training initiative, the STIR program. Some of you will be familiar with it; it was a superb program. A very similar running together of teams of students across disciplines; from 2001 to 2011, when it was terminated, 300 students were trained. When it comes to training, we are doing something right and we have now imposed on this program an international component in which complementary teams in other countries exchange both intellectually and physically, creating the international ambassadors of the future. With CIHR, we also sponsor the CHRP program, with each agency contributing 10 million a year. There are currently 101 active projects, with 33 newly funded. In that program, each project has about 4-6 students a year; we estimate we are training 600 students in this cross- disciplinary fashion. But we are not done yet; we have to scale the program, we have to do it better and we have to incorporate an international component. So those are two programs. Let me move on to the Discovery Frontiers program. This program invests $1M a year for four years (from NSERC) and we have partnered with other agencies in the past; for example, an initiative in bio-formatics involved CIHR, CFI and Genome B.C to build something robust. Ted Hewitt, President of SSHRC, and I were just in Brazil last week talking to their granting councils and also top researchers to explore partnerships with this program, among others.. One such initiative was a new call through the Discovery Frontiers program, with international partnerships, on Anti-Microbial Resistance. Such a call would include SSHRC, CFI, CIHR, Genome Canada, and the Public Health Agency of Canada.

Finally, our most extensive program between NSERC, SSHRC, and CIHR is the Network of Centres of Excellence (NCE) program. This program invests an average of $5-6M a year in each network with no time limit, subject to performance and relevance. All of these NCE projects sport international partnerships and involve the extensive training of students and postdocs.

All of the programs that I have highlighted involve the training of students, they involve international networks and I think that really is our task for the future: to make the case very effectively that we do

high-end skills development for the future of the country. So that's the very simple message that we are pitching.

So I will end as I always do in my speeches to different stakeholders with a simple thought: We must return to the concept of a Ph.D. as a Doctor of Philosophy, not a Doctor of Biochemistry, not a Doctor of Mathematics, but a Doctor of Philosophy. We are trying to train our students in the art of creative, critical, and adaptive thought for tomorrow's challenges.

Mr. Paul Davidson: Thanks very much Mario.

Supreme Court of Canada, Ottawa

Honoured Guest

Discussant

Dr. Alan Bernstein

Dr. Alan Bernstein, O.C., FRSC, FCAHS
2017 Friesen Prizewinner
Alan Bernstein is CIFAR's President and Chief Executive Officer of CIFAR since May 2012.

Most recently, Dr. Alan Bernstein was executive director of the Global HIV Vaccine Enterprise in New York. From 2000 to 2007, he served as the inaugural president of the Canadian Institutes of Health Research (CIHR) and led the transformation of health research in Canada.

After receiving his PhD from the University of Toronto, and following postdoctoral work at the Imperial Cancer Research Fund in London, Dr. Bernstein joined the Ontario Cancer Institute. In 1985, he joined the Samuel Lunenfeld Research Institute and served as Director of Research from 1994 to 2000.

Author of over 225 scientific publications, Dr. Bernstein has made extensive contributions to the study of stem cells, blood cell formation (hematopoiesis) and cancer. He chairs or is a member of advisory and review boards in Canada, the U.S., U.K., Italy and Australia. Dr. Bernstein also served as co-chair of the Scientific Advisory Committee for Stand Up 2 Cancer Canada with Phillip A. Sharp.

Dr. Bernstein has received numerous awards and honourary degrees for his contributions to science, including the 2008 Gairdner Wightman Award. In 2015, he was inducted into the Canadian Medical Hall of Fame. He is a Senior Fellow of Massey College, University of Toronto and, in 2002, was made an Officer of the Order of Canada. In March 2017, Dr. Bernstein was awarded the Henry G. Friesen International Prize in Health Research.

Observations

Thank you very much Ruth. I'd first like to start by congratulating Reinhard on a tremendous report. We talk about our politicians not using evidence, but academics are probably guilty of the same thing. This report fills that gap admirably. I think that the data in the report is very useful for reasons that have been discussed so I am not going to repeat what has been said in terms of where our students go after they graduate. In brief, they are not all clones of their supervisors. And if you think about it, they can't be. I don't know the average number of students a PI trains over their career but it's probably in the order of 20. If these 20 students all were to go into academia, we would be growing to a power of 20. It's obviously just not possible and so we would be dooming our graduate students either to unemployment, taxi driving or completely switching careers. So clearly we have been selling them a bill of goods if our message is that unless you become a professor, you are second best. I think the data doesn't speak to that value judgement but it certainly speaks to the reality of what's been happening. Several years ago I was asked to speak at a careers conference in Toronto on alternative careers for PhD students. Alternative in that context, clearly meant if you didn't become a professor what else could you do? And I refused to participate unless the title was changed to "Careers for PhDs". I recently saw an ad in Nature from the NYU School of Medicine, co-sponsored by Nature Jobs, called 'What can you do with a PhD?'. It's happening next week and its really interesting to look at the topics: bench science and private industry, careers in teaching and education, careers in finance and equity

research, careers in non-profits and foundations. Thats all between 10-12 on Saturday morning. Early afternoon: non-research industry careers, careers in data science, how to get published in Nature, patent law, schmooze or lose workshop. Late afternoon: consulting careers, careers in science outreach, careers in marketing, medical communications. And at the very end, late afternoon on the Sunday, faculty positions. I suggest the group around this table think about doing something similar in the Canadian context. Now, I think the discussants today made some important comments and I am not going to attribute to each of you and I am not going to re-summarize what you all said. Many of you referenced points I made yesterday that science is becoming interdisciplinary, international, and collaborative. On that note I think it was Martha who talked about leadership and providing our students with opportunities to talk to people in government.

Jim Woogett: We still do that

Dr.Alan Bernstein: I thought so, we had graduate students organize outreach which is a leadership opportunity and then you learn how to talk to people outside the academy. And they talk to young children in schools - a hugely valuable experience.

Jim Woodgett: Can I just add to that. One thing we have also done is that we extended that so we actually have students talking to donors directly as fundraisers. The donors want to be more engaged and they talk to you and me and they think oh we are going to put money into lights or whatever but they talk to the students and they see, they are an incredible asset. So they learn how to communicate how through the 3 minute PhD how to communicate to people who are not scientists.

Dr. Alan Bernstein: We all believe in learning by doing so I think that a way to learn how to talk to politicians and policy people is to talk first to donors and to kids in public school and high school. I think that's age appropriate for our Graduate students. My experience was that the brightest graduate students when I was the director at the Lunenfield were the ones who put their hands up first to do this.

I think that interdisciplinary research is an important issue. At CIFAR we have a program – the CIFAR Azrieli Global Scholars- for researchers within their first five years of an academic appointment. We bring them all together whether they are doing physics, the social sciences, biological sciences, cosmology, etc. This year they have asked to meet an extra day so they can just talk science. They love the opportunity. I think the message here is, that young people like including beginning assistant profs are starving for these interdisciplinary opportunities. Health Research has essentially become a crystallizing force, bringing together disciplines from across the physical sciences, engineering, humanities the biological sciences and medical sciences and the social sciences. I think young people want the opportunity to attack a problem not a discipline. Problems don't easily fall into disciplinary boundaries and so I think this is an opportunity to re-orient the graduate student experience around a problem, not a discipline. I know that's a challenge for universities. That's what our young people want and that's what they should want. Science is about tackling problems, not a discipline. And so the second point I would make is that science in intrinsically interdisciplinary. Our graduate students want that opportunity and it should be part of their experience. Mario, you referred to NSERC's terrific CREATE program modeled after CIHR's original training initiative in health research the STIHR program. It was a great program and I am very pleased that NSERC has picked it up in the CREATES program. So I'll make the suggestion that CIHR and NSERC collaborate by creating a joint training program. I think that is the best way for our granting agencies to support graduate training.

CIHR's STIHRS program speaks to networking aspect of research that you talked about Anne. One of

the STIHR programs, the Canadian Clinician Scientist Training Program, based at the Hospital for Sick Children in Toronto, but national in scope, brought together clinician scientists doing paediatric research across Canada. The Program included an annual meeting where trainees presented their research, invited guest speakers, and generally took ownership of these meetings. A great hands-on leadership experience. I don't think you can teach leadership, I don't think you can teach how to talk to a politician. I think you do it. We wouldn't teach how to pipette, you pipette. These are important opportunities for all of you to work on or to think about at least.

When I was president of CIHR, we held a meeting on the Future of the University in the 21st Century at the Banff Centre. We invited senior university administrators and people from industry who had worked in universities. It was a very interesting meeting. One of the presentations that stood out for me was by David Pulleyblank a former math professor at the Universtity of Waterloo, and then a VP at IBM. David remarked that in industry, you are expected to work in teams unless you are a really really senior person and have contributed a lot to the company. In academia, you are expected to prove you can work on your own until you have been promoted and tenured. Then you can finally work in a team. Industry's view is that they cannot evaluate an individual, except by their contributions to a team. In academia we say we can't evaluate faculty working in a team, they can only be evaluated on their individual merits! So if a large number of our graduates are going into industry as we heard from Prof. Reithmeier, there's a corollary: they need to learn how to work in teams because that's how industry works.

Working in teams is not just preparing our students for industry. It's where research is headed. And, at its best, it's rewarding and fun. But working in teams - collaborating across disciplines and frequently across countries and therefore cultures - is hard. It requires listening skills, patience, appreciation of the value of diversity and a dictionary to understand the jargon used in different disciplines.

You have to listen, you have to be respectful, you have to understand different perspectives, you have to contribute to the conversation but not dominate the conversation, and there are multiple dynamics in any kind of true collaborative experience. And so if we are preparing our students for the real world, including the real world of research, we have to prepare them for teamwork. And I would submit that we are not. So I suggest we start thinking more about how we do that as part of the PhD experience. That's where science is going.

At CIFAR, we bring together some of the world's top scientists - regardless of discipline or country - to tackle questions of importance to the world. Over our 40 years of experience, we have learned that true problem-based, deep discussions that transcend traditional academic boundaries requires patience, excellence and a commitment to the question at hand.

Interdisciplinary problem-based research does not necessarily mean compromising excellence. Indeed, I would argue that it should, and frequently does, require excellence at the very highest level. But it's hard.

Honoured Guest

Discussant

Dr. Henry Friesen

Dr. Henry G. Friesen, C.C., FRSC, FCAHS
Distinguished Professor Emeritus, U Manitoba

A renowned and visionary medical scientist, Dr. Henry Friesen is a Canadian endocrinologist credited with the discovery of human prolactin, and for redefining medical research in Canada. Now a Distinguished Professor Emeritus of the University of Manitoba, Dr. Friesen was a Professor and Head of the Department of Physiology and Professor of Medicine. As President of the former Medical Research Council of Canada, he brought together scholars, scientists, practitioners, governments, industry and patient groups, and inspired the creation of the Canadian Institutes of Health Research. His integrity and selfless idealism attracted the support of thousands of advocates and admirers, both nationally and internationally. He fostered and nurtured the creation of Friends of CIHR.

Dr. Henry Friesen is featured in the Video History of Medicine in Canada Project by FCIHR see highlights from his interview here: http://www.fcihr.ca/video-history-of-canadian-medicine/

Observations

Thank you very much. I listened with great interest to various views expressed and will echo what others have said by expressing appreciation to Reinhart for his analysis of the employment, activities and roles of a very large cohort of U. of Toronto graduate students a number of years after they graduated. I think his study will become a classic that many will reference as they project future employment prospects of graduate students as they move into the workplace.

I couldn't help but be reminded of the words penned by Tennyson spoken by Ulysses at the end of his voyage "I am a part of all that I have met; yet all experiences are like an arch through which gleams the untraveled world whose borders move forever and forever when I move"

It was true for all of us as it is for graduate students as they are entering the new workplace environments—"the borders move forever and forever" and the landscape keeps changing depending on the experiences encountered. Ulysses reminds us that resilience is required to adapt to those life changing experiences. Instilling graduate students with the tools and confidence to overcome and resolve unexpected challenges is an important part of their training.

The diversity of views on elements of graduate training expressed here today is really quite interesting and remarkable. I was particularly fascinated by Martha Crago's account of her approach in supporting students with very different cultural backgrounds--- how very creatively she adapted the thesis defense procedure to accommodate the student's background. The academic world needs more Martha Crago's innovations.I wonder Ed Kroeger since you mentioned the top 5% of elite students how those were identified whether over time your prediction that they were truly elite would be borne out by their future performance.

One other point I would like to raise is to recognize that there are a whole range of opportunities and approaches to training graduate students. I think all of us would agree there is no single approach that works for everyone. It's just like raising your own kids-- each one comes with a different personality and talent; so one has to be flexible in approaching and managing their growth and maturation. I will conclude with one of my favourite quotations which I think applies here as it underscores that there is a certain amount of humility required of us all when offering opinions about optimal graduate training methods.

Archibald MacLeish the American playright wrote—" the answers, the answers we know, the questions we know not how to ask". So I think we need to keep searching to ask the right questions, because in the end we will be more successful if we focus on getting the questions right rather than trumpeting our "right answers".

Dr. Henry Friesen: I would like to pick up on the discussion on "how do you speak to government?" First, some of us like myself who have had the opportunity to show leadership in advancing the case for more government funding for research weren't particularly trained for this task but we did learn valuable lessons on the job. Secondly, it would be wrong to suggest that the approach to government is unidimensional. There is a very different set of expectations when you go and speak to Deputy Ministers or Director Generals versus when you speak to the Minister.Third, there is also a misconception, a myth that it is most important to speak to the Minister first; in fact that probably is the last person to approach and only after having made the case with others first.

When approaching government my political mentor reminded me that preparatory work to building a relationship, an understanding and appreciation for the case is vital. To illustrate the point I will relate an anecdote offered to me soon after I became President of the MRC. Bill Liaskas my political mentor served 2-3 years as Chief of Staff to the Hon. Perrin Beatty during his tenure as Minister of Health. He related to me that during this period the correspondence unit of the department of health answered about 90,000 letters or some thing of that sort. He said," you know we never had a single letter of appreciation or thanks from any of the MRC grant recipients who would have received well over 500 million dollars of research grant funding during this period." I said,"Bill, mea culpa". It never occurred to me in the 25 years that I had received MRC research grant support either when I was at McGill or the Univ. of Manitoba that I should write a thank you letter to government ministers. I had worked hard to compete for these grants---really in hindsight I treated these grants as my my entitlements. I could immediately see the point Bill had made, a point of view reinforced subsequently when Members of Parliament reminded me explicitly that in their experience grant recipients from Council funding were not particularly grateful people.

So speaking to government can take place at many different levels. A graduate student, a grant recipient each or both can speak or write to Members of Parliament. No where is that case better made than in the constituency office. One doesn't need to come to Ottawa. You are more likely to see your member of parliament locally than you are in Ottawa. One other observation--- a key element in making a convincing case is that trust has to have been established between the interlocutor and the government official whether it is the minister, the deputy, or whoever. It is essential that he or she has confidence in you, that you have built a relationship where there is a high level of trust between between both parties and then they will be really listen carefully to whatever representations you make.

Mr. Paul Davidson: And just to build on that for a second, trust takes building the relationship its not around asking for money. Its around giving good advice and thanking. Certainly that has been my advice to young investigators not down to the graduate student level say thank you first, say why you think the money has been so useful for Canada don't ask for money everybody asks for money so if you want to differentiate yourself in-front of a politician especially a cabinet minister or a senior individual it is about building a relationship and that feeling you are not just another person asking for money.

Dr. Henry Friesen: One further anecdote to illustrate the power and significance of personalizing the message. I remember when Mr. Martin Min. of Finance in the 1998 budget reversed all the cuts made to the Tri Council Budgets including the MRC during program review. The way the system works if someone writes to the Minister the letter comes back eventually to the relevant agency (the MRC) to draft a reply for the Minister. So I received a letter sent to the Minister of Finance, Mr. Martin to provide him with a draft reply. It was a handwritten letter from a woman in Windsor.-- I paraphrase but it stated the following:" Dear Mr. Martin, You will not remember me but I looked after your mother when she was in the hospital and you were a little boy playing on the bed. I am just writing to thank you for your decision to reverse the cuts to the budgets of the granting councils. As a result my son has received a scholarship which will now ensure he remains in Canada to complete his studies as opposed to going to the United States which was the option that he would have taken. Thank you very much."

One letter like that I assure you has a powerful influence on key decision makers then they will really listen carefully.

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