MD/PhD Program—University of Toronto

Pair O Docs

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A Critical Assessment of Clinician-Scientist Training

Editorial by Dr. Norman Rosenblum, MD, FRCPC, Director, MD/PhD Program

The success of students in the University of Toronto MD/PhD Program is impressive – high impact publications, awards, and important contributions to the University and to the community beyond the university. It is easy to imagine the power of the contributions our students will make in future years, consistent with the important achievements of MD/PhD Program graduates across North America. Indeed, approximately 65% of University of Toronto MD/PhD graduates develop a career as a physician scientist. This outcome is consistent with findings generated from a follow-up study of over 1600 graduates of USA Medical Scientist Training (MD/PhD) Programs after postgraduate training.

Notwithstanding the success of physician-scientist education, we are compelled to examine the model of training physician scientists in the face of an ever-dynamic environment in the public and private sectors. In many ways, the educational model for physician scientist training has been static for decades. It is time for a careful review.

Accordingly, with the support of my decanal colleagues, I established a Task Force on Physician Scientist Education in the fall of 2011. The Task Force is charged with reviewing the landscape for physician scientist training and career development, and evaluating existing physician scientist training programs at the University of Toronto and across North America. The Task Force will recommend the kinds of programs that are needed to develop the physician scientists of the future and the relation of these programs to existing programs.

The Task Force has been informed by a survey of current University of Toronto MD/PhD Program students and Clinical Investigator Program trainees. Brian Ballios and Greg Costain, current MD/PhD students and members of the Task Force, demonstrated great leadership in developing survey tools, analyzing the results and presenting data to the Task Force. The MD/PhD student survey achieved a 82% response rate (bravo MD/PhD students!). Greater than 90% of respondents do not regret their decision to enter the MD/PhD Program, expect to become a physician scientist in academia after completion of postgraduate training and postdoctoral fellowship, and hope to engage in research during postgraduate training and continue to publish their

Dr. Norman Rosenblum

work. Results also indicate that MD/PhD students are concerned by lack of integration between the medical and PhD curricula during their training, the length of time it takes to complete undergraduate and postgraduate training, how their career will be configured

Continued on page 2

IMAGINE: an interprofessional, student-run clinic in downtown Toronto

By Enoch Ng

Left: Enoch Ng in front of IMAGINE clinic

In addition to their studies and research, MD/PhD students are active in serving the larger community. These include helping to organize pre-exam review sessions for first-years, creating and editing medical reference textbooks, to founding and overseeing community outreach programs. Here I focus on our work in developing IMAGINE (Interprofessional Medical and Allied Groups for Improving Neighbourhood Environment), an interprofessional, student-run community health initiative for marginalized populations in downtown Toronto. In May 2007, Sagar Dugani and other colleagues established IMAGINE (Dugani & McGuire, 2011) to meet two needs.

First was the need for student-led interprofessional activities in real-world clinical settings. Secondly, IMAGINE was founded to address the health service gaps experienced by marginalized populations in downtown Toronto. For example, according to a 2007 survey, homeless populations in Toronto were much more likely than the general population to have chronic conditions like hepatitis C, epilepsy, heart disease, major depression etc. and yet more than half did not have a family doctor and over a quarter refused health care in the past year because they did not have a health card (The Street Health Report, 2007).

With the support of over nine departments faculties at the University of Toronto, Dugani and the IMAGINE team developed a three-pillared approach to healthcare: 1) a drop-in health clinic at Central Toronto

Continued on page 3

Director's Editorial Continued

to include clinical activity and research, the sustainability of a physician scientist career and eventual career 'burn out'.

The results of the MD/PhD student survey are consistent with the results of our survey of the 110 trainees currently enrolled in the University of Toronto Clinical Investigator Program (CIP). 89% of CIP respondents (70% of all CIP trainees) intend on working as a physician scientist! The vast majority of our trainee respondents intend to complete CIP and become a principal investigator in an academic centre. These trainees indicate that their postgraduate programs are successful in training physician scientists, are happy to have undertaken research at this stage of their career, do not regret the decision to enter the CIP and agree that the mission of the CIP is to train future physician scientists. Similar to MD/PhD students, CIP trainee respondents cite concerns about the ability to maintain clinical skills while training in research, the advanced age at which they will obtain their 1st faculty position, their ability to obtain such a position, compensation as a faculty member (in comparison to their colleagues who do not do research), competitiveness in obtaining research grants, balancing work and family, and career 'burn out'. Trainees doing biomedical research are more concerned about their future success in contrast to trainees doing clinical research, clinical epidemiology and health services research.

It is gratifying that most MD/PhD students profess to having made the 'right choice' in their education and are committed to becoming a physician scientist. At the same time, it is clear that the training pathway is long, with little inter-relationship between undergraduate medical and graduate studies in the MD/PhD Program and between the undergraduate, graduate, and postgraduate programs. Trainees are anxious to develop a physician scientist career but express real concerns regarding the sustainability of that career pathway.

With these results as a foundation, the Task Force is, at this time, asking fundamental questions regarding the structure of physician scientist training at our university and career pathways at the faculty level. Critical issues include 'point of entry' into undergraduate MD-Graduate Science educational programs, the content and delivery of undergraduate medical curriculum for research-invested students and the interrelationship with graduate-level courses, the transition to postgraduate training from the undergraduate phase, integration of research and clinical training in the postgraduate phase, and faculty-level career development pathways that demonstrate value in the physician scientist.

It is, indeed, timely for MD/PhD students, alumni, medical school faculty, and stakeholders in the health research community to take part in this discussion – debate, perhaps – on what a physician scientist training pathway should look like. Here, at Canada's largest physician scientist training program, we have a chance to create 'change that can matter'. I invite you to share your data and express your views on these critical issues with me norman.rosenblum@sickkids.ca.

MD/PhD Class Council Update

Andrew Perrin (President), Gord McSheffrey (President-Elect), Brian Ballios (CITAC), Kevin Wang (CITAC)

Gord McSheffrey (left) and Andrew Perrin (right), class presidents

This summer a new class council was elected. Sagar Dugani completed his term as President and Gord McSheffrey joined the executive as President-Elect. Andrew Perrin transitioned to the presidency of the Class Council for 2011-2012.

A key initiative for Andrew and Gord is the development of three informal mentorship events for students in the MD/PhD program. By creating annual get-togethers for students facing, respectively, the MD to PhD transition, the PhD to MD transition, and the transition to clerkship, Andrew and Gord hope that junior trainees will benefit from the knowledge accrued by senior trainees and that this will alleviate the considerable stress that arises around these transitions. Stay tuned for future developments on this front!

Along with other members of the MD/PhD Class Council, Andrew and Gord are working closely with the MD/PhD representative to the University of Toronto Graduate Student Union (GSU), Jonathan Fuller. Our aim is to increase the visibility of MD/PhD students within the greater graduate student body at UofT and to secure stable funding for our class council through the GSU budgetary process.

The Student Affairs Liaison Team (SALT) is a committee of students from the MD and MD/PhD programs that aims to promote student wellness within the Faculty of Medicine. Over the past year, the 2010-2011 SALT representatives, Laura Erdman and David Tsui, worked diligently with MD/PhD student Greg Costain and the MD/PhD executive to create a handbook specifically for MD/PhD students at the University of Toronto. This handbook, which is now available in pdf format on the MD/PhD program website, provides guidance on all major aspects of the MD/PhD journey at the University of Toronto. We laud Laura, David and Greg for their outstanding efforts in creating this resource.

As in previous years, the SALT representatives will be organizing a series of review sessions for first-year MD students at the University of Toronto. These reviews session have proven highly successful in past years and we hope that they will continue to receive a positive response from medical students.

MD/PhD students at the University of Toronto continue to be strong supporters of the Clinician Investigator Trainee Association of Canada (CITAC). Over the past few years, CITAC has aimed to increase its membership and to improve the resources for clinician-scientist trainees in Canada. Toronto MD/PhD student Sagar Dugani, who recently assumed the presidency of CITAC, is looking to further these aims over the coming year. With Toronto MD/PhD student Jared Wilcox set to succeed Sagar as CITAC President in 2012, University of Toronto MD/PhD students are now uniquely poised to have a strong influence on the continued development of CITAC.

Continued on page 3

Class council update - *continued from page 2*

The 2011 CITAC annual meeting took place from September 12-14 at the Delta Ottawa City Centre. University of Toronto MD/PhD students were well-represented, with Gord McSheffrey and Linda Vi delivering oral presentations and Andrew Perrin winning an award for his poster presentation. An exciting development at the CITAC meeting was the increased attendance of MD+ trainees from across Canada. From the University of Toronto alone, 6 MD students with a strong interest in research attended the various mentorship and research events that comprised a highly productive CITAC meeting. The CITAC meeting continues to provide an excellent forum for professional development and mentorship and fosters relations between trainees and the broader clinician-scientist environment.

It has been a very productive year for your Class Council and, as always, we are happy to hear your feedback. All the best for a productive and happy academic year!

IMAGINE - *continued from page 1*

Community Health Centre, 2) community outreach and health education workshops at St. Christopher House and other agencies, as well as 3) a lecture series where experts present on inner-city health. IMAGINE's drop-in clinic welcomed its first clients in October 2010. Now on Saturdays during the academic year, the clinic offers free health services with no need for ID, OHIP and appointments (torontomeds.com/imagine). Currently the volunteer clinical team is composed of five students and five licensed preceptors from medicine, nursing, pharmacy, social work, and physiotherapy.

In August 2011, I had the privilege of taking over as an IMAGINE co-director from Dugani. Since then, I have worked with our interprofessional executive to improve awareness of our clinic to our target population, streamline the clinic flow, evaluate our services in response to patient needs, and integrate other health professions into our clinic team. We also plan to launch a series of qualitative and quantitative research projects to assess the impact of IMAGINE on students' attitudes toward interprofessionalism and marginalized populations. Preliminary analyses data by Dugani *et al.* in preparation for publication suggest the clinic is filling an important gap in care, with >50% clients not having OHIP, >65% not having a family doctor, and >20% not having a fixed home address.

Indeed, IMAGINE's unique model of care has attracted recent media attention from outlets such as Torontoist, and CTV news, CBC radio. I sincerely hope that IMAGINE will inspire other student-led initiatives and that MD/PhD students will continue to use their unique perspectives and more flexible PhD schedules to serve the larger community.

Graduate In Focus: Dr. Bryan Lo pursues basic science research at Genentech

Dr. Bryan Lo is a medical geneticist, currently conducting basic science research in the Department of Research Oncology at Genentech in South San Francisco. After completing his residency in medical genetics at University of Toronto and a locum as a staff doctor at Hospital for Sick Kids, Dr. Lo moved to the United States to pursue a research fellowship in the laboratory of Prof. Ira Mellman at Yale University. Two years later, Dr. Lo joined Prof. Mellman in a move to Genentech, to see firsthand what it was like in one of the world's leading biotechnology companies. He has been at Genentech for the past five years, and describes his experience there as, "a wonderful opportunity to engage in curiosity-driven research in a highly collaborative environment filled with exciting translational research".

Dr. Lo's research primarily focuses on the cell biology of cancer and has developed technigues to manipulate oncogenes and tumour suppressors in mouse embryonic tissues. His main goal is to investigate how epithelial cells maintain shape and position within complex tissue systems, in order to better understand how cancer develops. By inhibiting genetically modified kinases in mouse embryonic tissues, Dr. Lo combines the specificity of genetics with the temporal control afforded by small molecule inhibitors. Taking a reductionist approach, Dr. Lo focuses on how one or two perturbations within a developing tissue can affect cell polarity, shape, and lineage. Findings from his research will broaden our understanding of cancer initiation and perhaps provide platforms for developing novel therapeutics.

Dr. Bryan Lo with his daughters in California

As an undergraduate, Dr. Lo became interested in the way clinician scientists have been able to recognize the relevance and utility of scientific discovery and how it can bring about positive changes to patients' lives. He therefore enrolled in the combined MD/PhD program at University of Toronto. After completing his PhD training under the supervision of Dr. Mel Silverman, Dr. Lo remembers having anxiety about the transition back to the MD training. Dr. Silverman knew what he was going through, was very supportive and arranged for him to participate in a couple of clinics prior to his clerkship rotations. It was helpful, but in hindsight, he says, "once you get thrown into it, you survive, and you work extra hard to catch up. You remember that you have great teachers who can help and give you guidance".

His interest in medical genetics was peaked during a clinical elective at Sick Kids in his third year of medical school. The cases he saw in the genetics clinic were especially meaningful, because the approach involved not just a single patient, but sometimes the entire family and even the extended family. Also, the conditions being assessed by medical genetics were particularly challenging since they were neither confined to a single organ system nor any one particular age range. Seeing how careful clinical characterization of genetic disease can provide insight into fundamental biology, he was drawn into the field of medical genetics. As far as personal anecdotes go, Dr. Lo remembers how fortunate he was to see a patient with glucose-galactose malabsorption syndrome during his residency. This

Continued on page 7

Graduate In Focus: Dr. Michael Demetriou connects autoimmunity and protein glycosylation

Michael Demetriou is a neurologist at the University of California, Irvine (UCI), who is studying protein glycosylation in the pathobiology and treatment of autoimmune diseases with a special focus on multiple sclerosis. Dr. Demetriou studied biochemistry at the University of Toronto Trinity College for 3 years, and entered medical school, joining the MD/PhD program after first year. While in the program he studied for both degrees concurrently in the lab of Jim Dennis on glycoproteins related to cancer. When it came time to decide what to choose for a residency, Dr. Demetriou chose neurology thanks to a love of the puzzle "find the lesion" despite the field having no obvious connection to the cancer research he did during graduate school.

Dr. Demetriou soon realized that a knockout mouse of one of the genes he studied during his PhD revealed an autoimmune phenotype. He published a seminal paper in Nature that linked protein glycosylation to T-cell hyperactivity. After completing his neurology residency, he decided to take a position at UCI where he had an influential mentorship with Stanley van den Noort, a renowned clinical expert in multiple sclerosis. Dr. Demetriou's research time was protected while he set up his lab and applied for funding, an aspect of his career that he identified as a key to success. He currently spends 90% of his time on research, and 10% in the clinic.

Dr. Demetriou recalls the challenges of being an MD/PhD student and leaving his medical school class, doing well in graduate school, and then returning to medical school to a different style of thinking. Like many of us, he felt as if he had two different compartments in his brain—the memorizing (clinical) and the mechanism (research) ways of thinking. He figured out a way to merge the two, and stresses the importance of using clinical perspective to ask unique questions. Going from bench to bedside, Dr. Demetriou has succeeded in rescuing T-cell

hyperactivity in mouse models of type 1 diabetes mellitus and multiple sclerosis just by administering the simple sugar N-acetyl glucosamine. He is currently investigating this treatment in clinical trials in humans.

MD/PhD Graduating Class of 2011

Phedias Diamandis (Neuropathology, U of T), Dr. Norman Rosenblum, Neil Goldenberg (Anaesthesia, U of T), Ben Steinberg (Anaesthesia, U of T), Michael Ward (Internal Medicine, UofT), and Chris Franco (Internal Medicine, UBC).

PhDs Completed

Grace Lam, Institute of Medical Science (John Brumell, supervisor) The Role of Innate Immune Factors, Autophagy and NOX2 NADPH oxidase in L. monocytogenes Pathogenesis. January 18, 2012.

Laura Clarke-Donaldson, Institute of Medical Science (Derek van der Kooy, supervisor) Proliferation and Potential of Neural and Retinal Stem Cell Populations. August 24, 2011.

Laura Erdman, Institute of Medical Science (Kevin Kain, supervisor) Host Inflammatory Pathways in Malaria Infection: Potential Therapeutic Targets and Biomarkers of Disease Severity. July 15, 2011.

Student In Focus: Andrew Perrin

By Natasha Lane

Andrew Perrin completed his PhD studies in 2011 under the supervision of Dr. Brent Derry in the Department of Molecular Genetics. Through his in vivo research using *Caenorbadditis elegans* as a model organism, Andrew studied how growth-factor signaling antagonizes programmed apoptosis. Persevering through the challenges of working with *C. elegans*, Andrew gained insights into how the protein kinase Akt is regulated by ionizing radiation. Specifically, he found that Akt is regulated independently of canonical PI3K signalling in response to ionizing radiation. He also discovered a growth-factor independent link between Akt and the DNA damage-responsive kinase ATR.

Andrew's research is published in Current Biology and the Journal of Immunology. He has also received numerous accolades at national research conferences (see page 8). In addition to his work in molecular genetics, Andrew's insights into the education of clinician scientists and the importance of diverse learning environments for medical students have been published in the Canadian Medical Association Journal and the Journal of Cancer Education.

Currently, Andrew is the President of the MD/PhD class council at the University of Toronto, and is working closely with his successor, Gord McSheffrey to create a series of mentorship events for MD/PhD students in Toronto. He also played a key role in developing the first UofT MD/PhD student handbook, which acts as a step-by-step guide to navigating the MD/PhD educational path.

Andrew is currently in the clerkship phase of the 3rd year MD curriculum, and is fascinated by Internal Medicine, Dermatology, and Psychiatry. Although he remains undecided about his medical specialty, Andrew looks forward to a career as a clinician scientist at a major academic centre. We wish him continued success and the best in his future pursuits.

Introducing the Incoming MD/PhD Students of 2011

From left to right: Lianne Rotin, Robyn Elphynstone, Ayan Dey, Linda Vi, and Natasha Lane (below is Jennie Pouget).

Ayan Day

I did my undergraduate degree at McMaster University in the Psychology, Neuroscience and Behaviour Program, and I chose the MD/PhD program at U of T for several reasons: the long-standing track record of excellence in research and medical education, rigour of the MD and PhD programs, very diverse and conducive research environment, assured funding with the option of pursuing my research interests in any discipline of my choosing, and the great support system for MD/PhD students (seminars, workshops, student groups, etc.).

Aside from research, I'm a bit of a technophile who is eager to try and master the newest gadgets. I am also experienced and very interested in Web Design and Photography.

I am particularly interested in applying neuroscience to study new ways of assessing and treating neurological deficits arising as a result of acquired brain injury or neurodegeneration. Ultimately I would like to strive towards finding new and innovative ways to use technology to streamline care and improve the patient prognosis and quality of life. I feel my training in this program will allow me to better appreciate and balance the competing demands of clinical practice and research and development.

Robin Elphynstone

I grew up in Lac La Biche, a small town in northern Alberta, before going to the University of Calgary where I graduated with a BSc. in Cellular, Molecular, and Microbial Biology with a minor in dance. During my undergraduate studies, I became passionate about the relationship between clinical medicine and scientific research. I chose the U of T MD/PhD Program because it allows me to combine both of these. In addition to being a great program with an excellent reputation, the U of T has a large department of immunology, and an incredibly supportive team of staff and students. Toronto also has several amazing dance schools, such as the National Ballet School and the School of Toronto Dance Theatre, where I am continuing both my ballet and contemporary dance training.

In terms of research I am fascinated by the microscopic world, especially with regards to our immune system and how we fight disease. With this in mind, I joined Dr. Howard Ceri's lab during my undergraduate studies. In his lab, I was able to look at both the effect of using synergies of antimicrobials against bacterial biofilms and the impact of biofilms on a mucosal surface. This research further peaked my curiosity and I am looking forward to pursuing research for my PhD that examines the interactions between immune cells and invading pathogens.

Natasha Lane

I did my undergraduate degree in Biomedical Sciences and my Master's degree in Health Studies, both at the University of Waterloo. I chose U of T's MD/PhD program for the wealth of clinical and research opportunities it offers, as well as its highly supportive network of more senior MD-PhD trainees. In my spare time, I love to read, run, and search for places to cross-country ski in Toronto.

My research is focused on understanding how contextual influences impact health behaviours at the population level. Ultimately, I hope to combine clinical practice with health policy research as a clinician-scientist. I am excited to be pursuing this goal at U of T, where access to world-class resources and innovative health research is paired with incredible mentorship and individual support.

Lianne Rotin

I grew up in Thornhill, Ontario and then headed to McMaster University to complete a Bachelor of Health Sciences degree. During my years as an undergrad I had the opportunity to spend several summers as a research student at SickKids Hospital. These experiences allowed me to appreciate the interdependence of basic science research and medicine, and ultimately motivated me to pursue both disciplines. I chose to enroll in the MD/PhD program at the University of Toronto because of its excellent reputation. Being so close to family and friends is also an added bonus! In my spare time, I enjoy long-distance running and sampling all of the ice cream in the GTA.

I'm interested in studying how genetic mutations cause cancer.

Jennie Pouget

After growing up in Hamilton I completed my undergraduate degree in Bio-Medical Science at the University of Guelph. It was here, under the mentorship of Dr. Patrick Boerlin, that I discovered my passion for research and had the opportunity to contribute to several projects investigating the molecular epidemiology of antimicrobial resistance genes. Eventually this training led me to develop my own project investigating the epidemiology of extraintestinal *E. coli* infections by assessing the virulence genes present in these pathogens.

Since then my research interests have shifted from infectious disease to mental health, and as an MD/PhD student I hope to pursue research investigating the epidemiology of neuropsychiatric disorders. I was drawn to this program because I feel that integrating my training in clinical and academic medicine will best prepare me to make a positive impact on patient care as a clinician-scientist. I chose the MD/PhD program at U of T because of the program's reputation as well as the quality of research here, which will allow me to learn from international leaders in the field of mental health. To relax I enjoy running, reading, and spending time with friends and family.

Linda Vi

I grew up in Mississauga and after high school, I moved to London to pursue an undergraduate degree in Health Sciences at Western. It was during my undergrad that I was first introduced to this amazing field of research. Working with Drs. Bing Siang Gan and David O'Gorman, I studied the role of the extracellular matrix in the pathophysiology of Dupuytren's Contracture. Here, I came to discover my fascination over exploring the

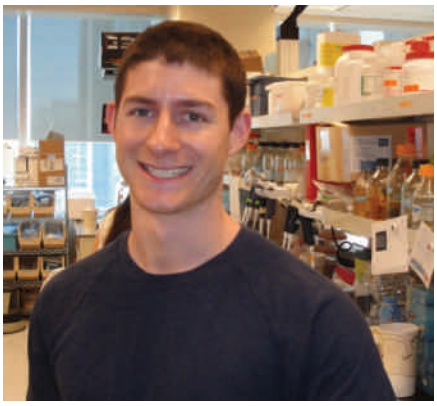
Continued on page 6

Incoming MD/PhD Student Bios Continued

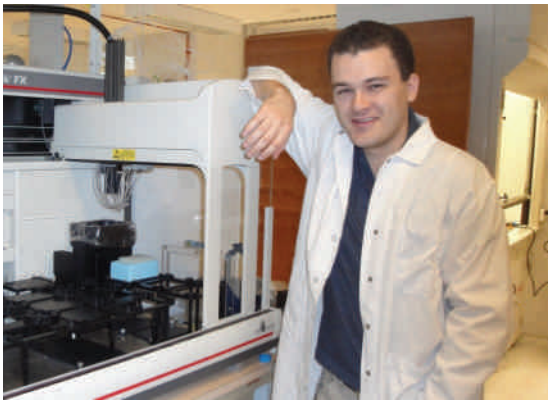
unknown and my interest in matrix biology. This compelled me to pursue a Master's degree in Physiology working with Dr. Lina Dagnino, where my thesis work focused on elucidating the role of ILK in dermal wound closure. Together, my previous experiences have led me to my interest in matrix biology and its role in tissue repair and regeneration after injury. An area of study, I hope to pursue during my MD/PhD training. I chose to pursue the MD/PhD program at U of T because of its well established program and the breadth of research opportunities available here. Outside the lab and classroom, in my dwindling spare time, I enjoy playing hockey, cheering on the Leafs, and hitting the driving range during warmer weather.

MD/PhD Students In Action

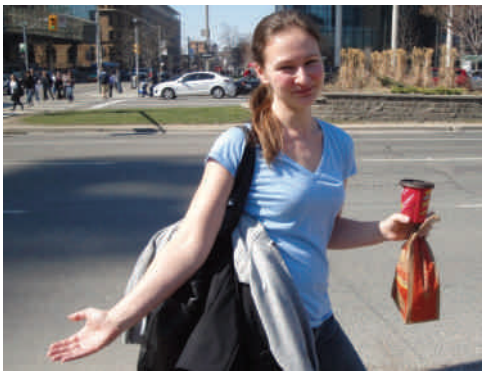
Brian Ballios with retinal stem cells in the hood



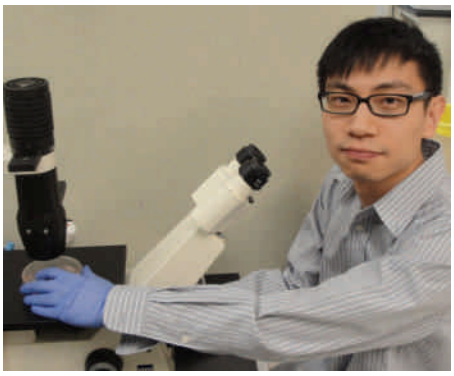
Rob Vanner in the lab with cancer stem cells



Kirill Zaslavsky has a great robot-human relationship

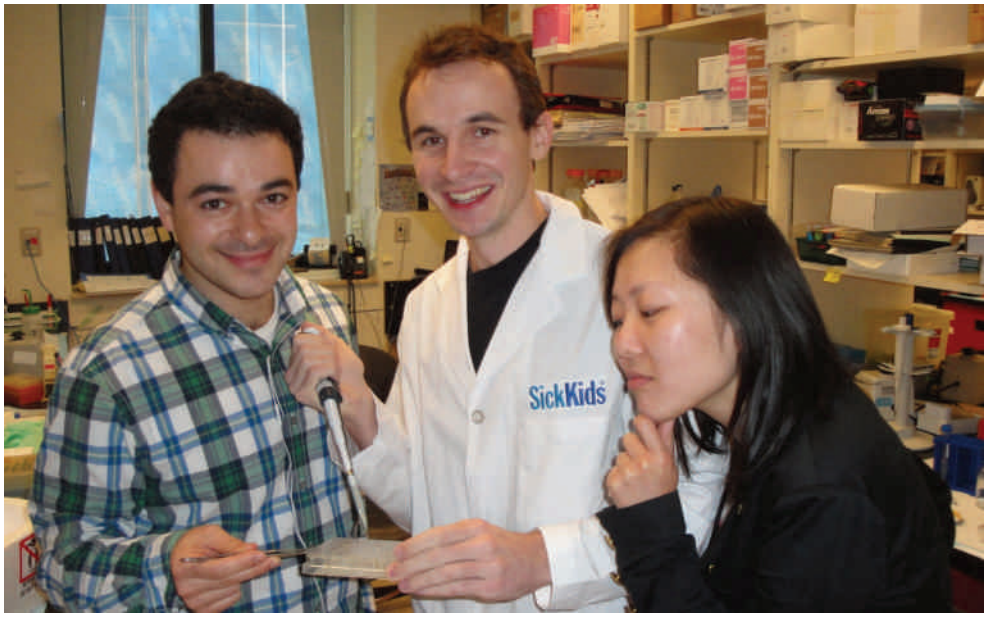


Dr. Laura Clarke on her way to lecture



David Tsui studies neural development

Jonathan Fuller ponders philosophy of medicine



Ilya Mukovozov, Mike Bohdanowicz, and Dr. Grace Lam do team science at The Hospital for Sick Children

Ashish Deshwar shows off his pink zebrafish

Find a mentor at the MD/PhD Mentorship Symposium

Jared Wilcox and Greg Costain (SALT representatives)

A recent survey of MD/PhD students and alumni undertaken to inform the ongoing Physician Scientist Task Force Committee revealed an overwhelming number of respondents (91%) feel mentorship plays a significant role in their training, and that lack of mentors was a factor for those who chose to withdraw from research.

The MD/PhD Mentorship Symposium (MMS) is a unique initiative that will address the importance of mentorship on Tuesday, April 17th at the Faculty Club, Toronto. The MMS is a one-day event that will give our trainees access to established clinician scientists and program alumni in one-on-one and small group settings, allowing trainees to find a match-fit mentor.

Using input from the student body, concurrent streams have been made to address the major concerns held by students at all years of the program. Discussion topics and breakout sessions cover personal and professional development, including: Maintaining Academic Productivity, Navigating the MD/PhD Landscape, Negotiating an Academic Position, and Striking Career/Family Balance. The MMS espouses a clear vision, striving to facilitate a collegial and informal setting for trainees to connect with alumni and clinician scientists across the entire career trajectory.

We would like to thank our sponsors for the upcoming MD/PhD Mentorship Symposium:

Graduate In Focus:

Dr. Bryan Lo - *continued from page 3*

is a very rare syndrome caused by mutations in the sodium-glucose cotransporter, the subject of his PhD thesis work. He thinks he might have not run into such a patient had he chosen any other specialty.

Dr. Lo describes his MD/PhD training experience as extremely valuable in his current research activities. While the PhD training taught him how to think critically, design experiments, and read the scientific literature, his clinical training has helped him put things in perspective. The clinical training forces him to think broadly and focus on the physiological and pathobiological aspects of a problem. During his current research activities, his clinical training constantly reminds him of the importance of trying to bring the basic science research back to benefitting patients. Research at Genentech moves at a rapid pace, and it has been a more than a full-time job, Dr. Lo says. From time to time, he is informed of ongoing clinical trials at the company, which is gratifying, yet a big part of him misses seeing patients, and he hopes that he will at some point be pursuing academic medicine again.

Publications

Armstrong SM, Khajoee V, Wang C, Wang T, Tigdi J, Yin J, Kuebler WM, Gillrie M, Davis SP, Ho M, Lee WL. Co-regulation of transcellular and paracellular leak across microvascular endothelium by dynamin and rac. *Am J Pathology 2012;180(3):1308-23.*

Pakulska MM*, **Ballios BG***, Shoichet MS. Injectable hydrogels for central nervous system therapy. (in press at *Biomedical Materials).*

Ballios BG, **Clarke L**, Coles BLK, Shoichet MS, van der Kooy D. The adult retinal stem cells is a rare cell in the pigmented ciliary epithelium whose progeny can differentiate into photoreceptors. (in press at *Biology Open).*

Cho N, Gilchrist C*, **Costain G***, Rosenblum N. Incorporating evidence-based medicine in the undergraduate medical curriculum: Early exposure to a journal club may be a viable solution. *UTMJ 2011;88:154-5.*

Costain G, Chow EWC, Silversides CK, Bassett AS. Sex differences in reproductive fitness contribute to preferential maternal transmission of 22q11.2 deletions. *J Med Gen 2011;48:819-24.*

Costain G, Chow EWC, Ray PN, Bassett AS. Caregiver and adult patient perspectives on the importance of a molecular diagnosis of 22q11.2 deletion syndrome. *JIDR E-published 6 Dec 2011 (doi: 10.1111/j.1365-2788.2011.01510.x)*

Costain G, Bassett AS. Clinical applications of schizophrenia genetics: Genetic diagnosis, risk, and counseling in the molecular era. *Application of Clinical Genetics. In press.*

Lou, X., **Deshwar, A.R.**, Crump, J.G., and Scott, I.C. (2011). Smarcd3b and Gata5 promote a cardiac progenitor fate in the zebrafish embryo. *Development*. 138: 3113-3123.

Dissanayake D, Gronski MA, Lin A, Elford AR, Ohashi PS. Immunological perspective of self versus tumor antigens. *Immunological Reviews 2011;241(1):164-179.*

Lin ACC, **Dissanayake D**, Dhanji S, Elford AR, Ohashi PS. Different toll-like receptor stimuli have a profound impact on cytokines required to break tolerance and induce autoimmunity. *PLoS One 2011;6(9): e23940.*

Dissanayake D, Hall H, Berg-Brown N, Elford AR, Hamilton SR, Murakami K, Summers Deluca L, Gommerman JL, Ohashi PS. Nuclear factor kB1 controls the functional maturation of dendritic cells and prevents the activation of autoreactive T-cells. *Nature Medicine 2011;17 (12):1663-1667.*

Lang PA, Lang KS, Xu HC, Grusdat M, Parish IA, Recher M, Elford AR, Dhanji S, Shaabani N, Tran CW, **Dissanayake D**, et al. NK cell activation enhances immune pathology and promotes chronic infection by limiting CD8+ T cell immunity. *PNAS 13 December 2011. doi: 10.1073/pnas.1118834109.*

Dugani S* and R McGuire*. Development of IMAGINE: A Student-Initiated Three-Pillar Program to Promote Social Accountability and Interprofessional Education. *J Interprofessional Care. 25(6):454-456.*

Boozary A* and **Dugani S*.** Institute of Social Justice and Medicine: A Think-Tank to Promote Policy Formation. *CIM. 34(5):E1-E3.*

Fuller J and Upshur REG. Logos, ethos and pathos in balance: Commentary on Miles and Mezzich. *Int J Person-Centered Medicine (In Press).*

Fuller J and Upshur REG. Medication regimen complexity and the care of the chronically ill patient. *Int J Person-Centered Medicine 2011;1(4):719-725.*

Fuller J. Darwinian medicine: the past and present state of medicine's unifying science. *UTMJ. 2011;88(3): 209-214.*

Hutson JR, Lubetsky A, Walfisch A, **Ballios BG**, Garcia-Bournissen F, Koren G. The transfer of 6-mercaptopurine in the dually

perfused human placenta. *Reproductive Toxicology 2011;32(3): 349-53.*

Hutson JR, Fischer HD, Gruneir A, Wang X, Daneman N, Gill SS, Rochon PA, Anderson GM. Use of clarithromycin and adverse cardiovascular events among older patients receiving donepezil: a population-based nested case-control study. *Drugs and Aging (In Press).*

Hutson JR, Garcia-Bournissen F, Davis A, Koren G. The human placental perfusion model: a systematic review and development of a model to predict in vivo transfer of therapeutic drugs. *Clin Pharmacol Ther 2011;90(1):67-76.*

Hutson JR, Lubetsky A, Walfisch A, Ballios BG, Garcia-Bournissen F, Koren G. The transfer of 6-mercaptopurine in the dually perfused human placenta. *Reproductive Toxicology 2011;32:349–353.*

Kapur B, **Hutson JR**, Chibber T, Luk A, Selby P. Methadone: a review of drug-drug and pathophysiological interactions. *Critical Reviews in Clinical Laboratory Sciences 2011;48(4):171–195.*

Hutson JR. Prediction of Placental Drug Transfer Using the Human Placental Perfusion Model. *J Popul Ther Clin Pharmacol. 2011;18 (3):e533-e543.*

Zhang SS*, Kim KH*, Rosen A*, Smyth JW*, Sakuma R*, Delgado-Olguín P, Davis M, Chi NC, Puviindran V, Gaborit N, Sukonnik T, Wylie JN, Brand-Arzamendi K, Farman GP, **Kim J**,et al. Iroquois homeobox gene 3 establishes fast conduction in the cardiac His-Purkinje network. *PNAS. 2011; 108(33):13576-13581.*

Lam GY, Czuczman MA, Higgins DE, Brumell JH. Interactions of Listeria monocytogenes with the autophagy system of host cells. *Adv Immunol. 2012;113C:7-18.*

Lam GY, Fattouh R, Muise AM, Grinstein S, Higgins DE, Brumell JH. Listeriolysin O Suppresses Phospholipase C-Mediated Activation of the Microbicidal NADPH Oxidase to Promote Listeria monocytogenes Infection.*Cell Host Microbe. 2011;10(6):627-34.*

Muise AM, Xu W, Guo CH, Walters TD, Wolters VM, Fattouh R, **Lam GY,** et al. NADPH oxidase complex and IBD candidate gene studies: identification of a rare variant in NCF2 that results in reduced binding to RAC2.*Gut. 2011 Sep 7. [Epub ahead of print]*

Muise AM, Walters T, Xu W, Shen-Tu G, Guo CH, Fattouh R, **Lam GY**, et al. Single nucleotide polymorphisms that increase expression of the guanosine triphosphatase RAC1 are associated with ulcerative colitis. *Gastroenterology. 2011 141(2):633-41.*

Patel S, **Mukovozov I**, Robinson LA. Assessment of the recycling of the membrane-bound chemokine CX3CL1. *Methods in Molecular Biology 2011;748:143-53.*

Škrtić M, Sriskanthadevan S, Jhas B, Gebbia M, Wang X, Wang Z, Hurren R, Jitkova Y, Gronda M, Maclean N, et al. Inhibition of mitochondrial translation as a therapeutic strategy for human acute myeloid leukemia. *Cancer Cell 2011;20(5):674-88. (featured on cover of issue).*

Nguyen LV*, **Vanner R***, Dirks P, & Eaves CJ. Cancer Stem Cells: an evolving concept. *Nature Reviews Cancer. 2012; 12: 133-143.*

Textbooks and Chapters

Browne A, **Dugani C**, **Hutson JR**, **McSheffrey G**, Stefater M. (Chief Eds.). **Ballios BG** (Assoc. Ed.) *Pharmacology You See: A high yield pharmacology review for health professionals. The Toronto Notes for Medical Students, Inc. Toronto, ON, Canada. 2011.*

Ballios BG & Browne AW Hematological Drugs. In Browne AW, **Dugani SB**, **Hutson JR**, **McSheffrey GG**, Stefater MA (Eds). *Pharmacology You See, First Edition (pp. 125-130). (2011). The Toronto Notes for Medical Students, Inc.: Toronto, Ontario, Canada.*

Ballios BG, **Hutson JR**, Stefater JA, Stefater MA Cardiovascular Drugs. In Browne AW, **Dugani SB**, **Hutson JR**, **McSheffrey GG**, Stefater MA (Eds). *Pharmacology You See, First Edition (pp. 53-72). (2011). The Toronto Notes for Medical Students, Inc.: Toronto, Ontario, Canada.*

Awards

Brian Ballios won a CIHR Banting and Best Canada Graduate Scholarship Doctoral (CGS-D) Research Award and a U of T SGS Conference Grant to attend Association for Research in Vision and Ophthalmology.

Greg Costain won a CIHR Vanier CGS-D Award 2011 and a U of T SGS Conference Grant.

Ashish Deshwar won the Roman Pakula Award from the Dept. of Molecular Genetics.

Dilan Dissanayake received an Honourable Mention for an oral presentation at the Canadian National Medical Student Research Symposium and won a UHN - Allied Health Research Funding Competition.

Sagar Dugani received the Golden Stethoscope Award from U of T Faculty of Medicine, and PAIRO Trust Fund Citizenship Award.

Jonathan Fuller was awarded the John Zoberman Scholarship, Mary L. Cassidy Award, and the CIHR Health Professional Student Research Award.

Janine Hutson is a co-investigator with Drs. Yaron Finkelstein, David Juurlink & Marco Sivilotti in a Creative Professional Activities grant from the Department of Paediatrics, Hospital for Sick Children, "Intentional self-poisoning in Canadian Teens: Identifying risk factors for future suicide and repeat attempts to facilitate secondary prevention – a population study"; she also won a 2011 Research Society on Alcoholism Student Merit Award.

Jieun Kim received Irwin Bernick Summer Medical Student Scholarship from Heart and Stroke Foundation of Ontario, and Milligan Graduate Scholarship.

Sean Nestor won a CIHR Banting and Best CGS-D Research Award.

Marko Skrtic's abstracts were awarded 1st place prizes at the 2011 and 2012 Medical Student Research Days at U of T; won an American Society of Hematology Abstract Achievement Award; won the Heidi Sternbach Scholarship, Postgraduate Medical Education, U of T.

Rob Vanner won a CIHR Vanier CGS-D Award 2011.

Florence Wu received a Keystone Symposia Scholarship for "Angiogenesis: Advances in Basic Science and Therapeutic Applications" meeting.

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