

the
iCAPTUR⁴E CENTRE/MRL
2001-02

From **CURIOSITY**
to **DISCOVERY**

PROVIDENCE RESEARCH VISION STATEMENT

In a culture of mutual inspiration that is integral and integrated, throughout every level of Providence Health Care, we will continuously search for answers that reach from bench to bedside; from molecules to communities; from mentors to learners; from knowledge to practice; and from curiosity to discovery.



Circle of Life
The 2001-02 Annual Review of the iCAPTUR⁴E
Centre/MRL

SHOWN: Dr. Stephan Van Eeden, iCAPTUR⁴E/MRL Researcher

2001-02

A Successful Second Year

for the **iCAPTUR⁴E/MRL** Team

LAST YEAR'S ANNUAL REPORT CELEBRATED the remarkable Canada Foundation for Innovation (CFI) award presented to the McDonald Research Laboratories at St. Paul's Hospital. During the last year, this \$17 million award was put into action with the development of plans for the "iCAPTUR⁴E Centre/MRL." Since the summer of 2000, the team has achieved additional successes, both in their research and in their efforts to build this pivotal heart, lung and blood vessel research centre.



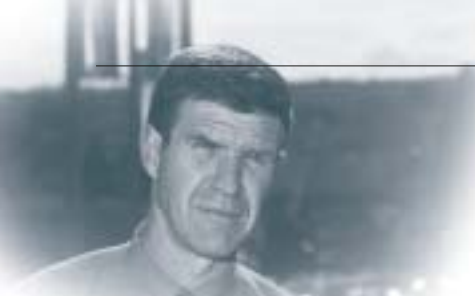
Progress in the Cores

CORE 1: Molecular Phenotyping

CORE 1 has made significant advances this past year. Not only has this team collaborated with international colleagues to study the gene expression of chronic obstructive pulmonary disease, virus-induced heart disease (with Drs. Tim Triche and Jonathan Buckley, University of Southern California), and heart valve disease (with Wyeth Ayerst researchers), but they have also been awarded a major grant to study genetic and environmental interactions from the Canadian Institutes of Health Research (CIHR). This grant, co-funded by the CIHR Institute of Circulatory and Respiratory Health and the Heart and Stroke Foundation of Canada, is a reflection of the impact of the CFI iCAPTUR⁴E infrastructure grants.

The CIHR "Gene-Environment" grant will enable the laboratories to establish a "high throughput" genotyping facility. With this new technology, the iCAPTUR⁴E team will be able to search for gene variations that increase the risk for developing certain heart, blood vessel and lung diseases, namely chronic obstructive pulmonary disease, asthma, atherosclerosis, aortic stenosis and systemic inflammatory response syndrome (sepsis). Information generated will help predict an individual's risk for these diseases, potentially enabling physicians to select more appropriate therapeutic interventions and/or advise patients appropriately regarding life style changes (e.g. diet, activity, smoking etc.) to minimize their risk. The impetus generated by the "Gene-Environment" grant will spawn new infrastructure and expertise in the iCAPTUR⁴E Centre.

Many other advances have occurred in the inter-related environment of CORE 1 and The iCAPTUR⁴E Centre. Dr. Yang and colleagues have advanced our understanding of Nip 21, IP-10 and IGTPase in viral heart disease. Studies of viral proteins in cell death are also well under way. Dr. McManus, Dr. Luo and colleagues have partially unraveled the role of kinase signaling in coxsackievirus infection. Other collaborative studies with Dr. Brad Spiller in Wales have revealed new possibilities for intervention in such infections by blocking the receptors.



A 2001 STUDY BY DR. STEPHAN VAN EEDEN and colleagues at Providence's iCAPTUR⁴E Centre/MRL at St. Paul's Hospital showed a clear link between air pollution and increased risks of heart disease and stroke. This pivotal study revealed that fine particles found in pollution can lead to plaque build-up in the heart's arteries. Dr. van Eeden's path of inquiry was triggered by his curiosity about why higher rates of heart attacks are reported on days when the air quality was poor. This curiosity led to a study that helped discover the mechanism by which pollution triggers the body's immune system to inadvertently clog its own arteries.

CORE 2: Ultrastructural Imaging

Using Transmission Electron Microscopy (TEM) and computer assisted serial section reconstruction, Dr. David Walker and his team have demonstrated, for the first time, that fibroblasts in the alveolar walls of the human lung form a cellular bridge between adjacent capillaries and alveolar type II pneumocytes. It appears that fixed apertures form connections between capillary endothelium and pneumocytes by way of fibroblasts. This observation is significant since such fibroblasts are in a position to direct the migration of white blood cells from the lung capillaries into the alveoli of the human lung, a role not ascribed previously to fibroblasts. These studies suggest that fibroblasts may be a prime target for therapeutic intervention in inflammatory diseases of the lung.

Using Transmission and Scanning Electron Microscopy, the Core 2 team has also examined the effects of alloimmunity and immunosuppression on vascular disease in a heart transplant model. A PPG (Project Program Grant) team funded by the Heart and Stroke Foundation of BC and Yukon (HSFBCY) has shown that, without sufficient immunosuppression, a transplanted heart is subject to progressive endothelial destruction including large intercellular gaps, missing cells and areas of bare extracellular matrix. Exfoliated surfaces were covered by platelets at various stages of adhesion, activation and spreading. Similarly, numerous leukocytes were observed as either adherent to the endothelial lining or moving into the sub-endothelial space. It was determined that stopping the administration of immunosuppressive drugs such as cyclosporine was also associated with development of similar abnormalities. Our findings indicate that, especially when immunosuppression is insufficient, early endothelial damage may promote vascular permeability and thereby initiate transplant vascular disease (TVD). This research by John Lai and his fellow HSFBCY PPG investigators in the McManus laboratory complements extensive functional and biophysical work carried out on allograft vessels in Core 3. Graduate student John Lai has presented this work at local and international research events such as the Frontiers in Cardiovascular Research conference in Seattle and it is now in press in full-length form.

CORE 3: Dynamic Cellular Imaging and Biophysics

A significant achievement for CORE 3 in 2001–2002 was the awarding of a St. Paul's Hospital Foundation/Canadian Institutes of Health Research (CIHR) New Investigator Award to Dr. Xiaodong Wang. The advanced technology of Core 3 will allow scientists like Dr. Wang to study vascular cells from diseased patients using state-of-the-art methods including simultaneous imaging and electrophysiology and confocal microscopy. The latter technologies produce dramatic real time and high-resolution imaging and records of normal and abnormal electrophysiological and biophysical events. Thanks to the personnel award, Dr. Wang will spend the majority of his time at the iCAPTUR⁴E Centre/MRL. This joint award will provide salary for Dr. Wang for five years.

Another key CORE 3 researcher, Dr. Issy Laher was part of a ground-breaking project that described a novel mechanism for the regulation of intrinsic vascular tone in small arteries. The paper authored by G. Lagaud, V. Karicehti, H.Knot, G.J. Christ and I. Laher and entitled

“Inhibitors of gap junction activity attenuate myogenic tone in cerebral arteries” is currently in press (*Am J Physiol*). In this study, the team provides the first evidence for intercellular communication and signaling during vasoconstriction caused by increased transmural pressure. They propose that communication via gap junctions maintains an average resting membrane potential and a synchronized vasoconstriction in small arteries. Disruption of gap junctions uncouples cell communications and results in oscillatory changes in membrane potential and a loss of myogenic vasoconstriction. This data represents a new mechanism and adds to our current understanding of the regulation of resting vascular tone.

Dr. Chun Seow and his team have published numerous peer-reviewed papers on airway smooth muscle mechanical function and ultrastructure in the last 12 months. They have provided the first ultrastructural evidence that myosin thick filaments in intact airway smooth muscle are labile; they can be partially dissolved by mechanical perturbation and by altered intracellular chemical environment, and that myosin light chain phosphorylation plays an important role in myosin filament formation in vivo. The findings furthered our understanding of how smooth muscle plasticity is regulated and how airway function is changed by muscle plasticity.

Dr. Seow has also been invited to co-edit a special issue of *Respiration Physiology* with Dr. Jeffrey Fredberg of Harvard School of Public Health that features review papers from world leaders in the field of airway physiology. The special issue will be published early next year.

Dr. Casey van Breemen and co-workers have also made remarkable progress during the last year. They have found that physiologic stimulation of large arteries and veins signals vascular tone through the initiation of waves of elevated calcium concentration, which move along the length of the thin smooth muscle cells around the lumen of the blood vessel. They have determined the mechanism of this wave formation, which is due to a complex interplay between the cell membrane and the internal organelles, namely the endoplasmic reticulum and the mitochondria. This is completely different from the older accepted model of vascular smooth muscle activation. They have also provided an explanation for why the blood vessel wall is capable of complete constriction, a process induced by extreme shortening of the smooth muscle fibers and the formation of surface blebs to accommodate for the displaced cytoplasm.

The van Breemen team also introduced for the first time, targeted aquorin (a luminescent indicator of calcium ions) into mitochondria of vascular smooth muscle to record large mitochondrial Ca^{2+} signals during excitation with pharmacological agonists. Approximately half of the mitochondria, which were superficially located, communicated with the cell membrane. The significance of these mitochondrial calcium signals is that they regulate energy metabolism and expand the cellular capacity to transiently buffer calcium ions.

The team also established a new role for endothelial NCX in mediating Ca^{2+} transport between the extracellular space and the endoplasmic reticulum. This observation helps to understand how the endothelium is able to secrete different relaxing and contractile factors with different types of Ca^{2+} signals. Thus if the calcium concentration is high near the cell membrane where NO synthase is located the cell will secrete the vasodilator NO. If however it is higher near the endoplasmic reticulum it will activate CyP 450 and release another dilating agent called EDHF. Another interest of this research group is the abnormal vascular activity seen in type 2 diabetes. They found that in obese mice, with type 2 diabetes, a vasoconstrictor, thromboxane A₂, was released from the endothelium during physiological activation of the arteries. The mechanistic insights gained in this study may be important for the development of future drug therapy. This new information was communicated in articles to *J. Physiol. (London)*, *Am.J Physiol (Heart and Circulation)*, *Cell Calcium*, *Brit.J. Pharmacol.* and *FASEB J.* It was also communicated as invited symposium talks in London (England), Paris, Lake Tahoe and Madison (Wisconsin).

CORE 4: Organ Pathophysiology and Imaging

This team continued to receive numerous awards for their work including the RSNA Research Trainee Prize in Radiology for detection of changes in blood flow after a lung embolism using spiral Computed Tomography (CT). The Stauffer Award for the Best Basic Science Paper was also awarded at the Association of University Radiologists meeting in April 2002. This paper focused on comparing Magnetic Resonance Imaging against CT in the evaluation of lung embolisms.

The team was also honored to receive the Cum Laude Poster Award at SPIE (The International Society for Optical Engineering) Medical Imaging 2002 in San Diego for their work on the development and validation of a new way to measure airways in the lungs of humans. This work is focused on their effort to develop CT image analysis software to measure airway luminal area and airway wall area and the comparison to quantitative morphology of excised human lungs as the gold standard. There is currently no accurate method to measure airway dimensions on the multi-detector CT. This algorithm will be extremely important in the continued scientific assessment of the structure and function of human airways.

Major Awards and Grants

iCAPTUR^{4E} Centre/MRL's senior investigators enjoyed several awards and honours in 2001–02. Laboratory Co-Director, **Dr. Bruce McManus**, was honoured with the John Foerster Distinguished Lecture Award from the Institute of Cardiovascular Sciences, St. Boniface Hospital and Research Foundation, Winnipeg, Manitoba, and was Honorary Chair for “The Cardiovascular System in the Era of Genomics and Proteomics,” at The University of Montreal. To wind up a truly remarkable year, Dr. McManus and his team were awarded an additional \$4.6 million from the Canada Foundation for Innovation for “Laboratory Upgrade for Animals of the Future,” an additional iCAPTUR^{4E} Centre/MRL facility enhancement.

In 2001, **Dr. Peter Paré**, Co-Director of the iCAPTUR^{4E} Centre/MRL and his team were awarded a \$2.7 million CIHR Interdisciplinary Health Research Team (IHRT) grant to study genetic and environmental contributions/interactions in inflammatory, cardiac, vascular, and pulmonary disease. Dr. Paré was also awarded a Michael Smith Foundation for Health Research (MSFHR) Distinguished Scholar Award and a Jacob Churg Distinguished Researcher Award. The Paré team's research focuses on the genetics and pathophysiology of asthma and chronic obstructive pulmonary disease.

Also in 2001, **Dr. Chun Y. Seow** received the CIHR/BC Lung Investigator award, a much-deserved five-year salary award to further his research on smooth and skeletal muscle cell physiology.

In addition to distinguished scholar awards, BC's Michael Smith Foundation for Health Research allocates funding for trainee and career awards, as well as other initiatives that will build health research capacity in British Columbia. At the iCAPTUR^{4E} Centre/MRL, these 2001 awards went to:

Trainee Awards — Biomedical (PhD):

Mitra Esfandiarei, “Cardiac Myocyte Apoptotic and Anti-Apoptotic Signalling Pathways Following Coxsackievirus B3 Infection,” Bruce McManus, Professor

Robert Yanagawa, “Host Cell Signalling Following Coxsackievirus B3 Infection: Elucidation of Anti-Apoptotic Survival Mechanisms,” Bruce McManus, Professor

Career Awards

Dr. John Hill — Scholar Award

Other iCAPTUR^{4E}-related trainees were also very successful in 2001–02. At the American Heart Association's Arteriosclerosis, Thrombosis and Vascular Biology Conference in May 2001, **Trina McIlhargey** from St. Paul's Hospital Healthy Heart Program's Atherosclerosis Specialty Laboratory received a New Investigator Award. This was a monetary award (\$1,000 USD) given to the top 30 abstracts for travel expenses. Shortly before the conference she was named one of five finalists for the Junior Investigator Award for Women. The finalists chosen for this award represented the top five abstracts submitted by women.

New Recruits

With the infusion of new monies, the iCAPTUR⁴E Centre/MRL has recruited new research faculty including confocal imaging expert, Dr. Tom Podor from McMaster University. Dr. David Granville, a cell biochemist who is currently at the Scripps Institute in La Jolla California, will be joining us in 2003.

Infrastructural Advances, 2001–02

In addition to the ongoing scientific pursuits at the iCAPTUR⁴E Centre/MRL, this team of researchers must also manage their CFI-funded infrastructure plans and finances. The renovations for their laboratories and office space are proceeding, with construction scheduled to begin in the Fall of 2002. The iCAPTUR⁴E Centre/MRL researchers, technicians, trainees, and students all contributed to overall space planning, an experience that assures that the facility is as conducive to productivity as possible.

In the educational realm, iCAPTUR⁴E has continued to improve its training and curriculum, setting up internal “Lunch and Lounge” and “Lunch and Learn” seminars for all levels of staff to encourage continued professional and personal development. Courses developed include a grant writing seminar, mock grant review committees, a “how to” for Powerpoint presentations, Library seminars, and, to keep everyone grounded, slide shows of staff vacations.

Technology

Throughout 2001 and 2002, the iCAPTUR⁴E administrators strengthened their current vendor relationships. IBM continues to provide the network and computer equipment for iCAPTUR⁴E Centre/MRL and are in very active discussions about areas of scientific collaboration. Many vendors made presentations about their imaging and molecular technology at in-house seminars for evaluation by staff. Further decisions on purchases of equipment will evolve as our new laboratory space is activated.

Communications and Knowledge Transfer

Interest in the iCAPTUR⁴E Centre's success with discovery and in attraction of funding continued throughout the year. This included extensive broadcast and print exposure for iCAPTUR⁴E in the Heart and Stroke Newsletter, Global TV Health News, The Vancouver Sun and Province and Chatelaine magazine. The administrative team also developed a brochure to inform new recruits, potential donors, and other interested parties building on the look and feel of iCAPTUR⁴E's inaugural annual report that was released in October, 2001.

Thanks to the hard work of the St. Paul's Hospital Foundation, the iCAPTUR⁴E Centre/MRL has been fortunate to host a number of potential donors and interested members of the public including international opera star, Ben Heppner, a spokesperson for the Lung Association.

The Future

Given this extraordinary time of growth, the iCAPTUR⁴E Centre/MRL will continue to work hard to leverage its initial CFI award into additional funding opportunities. Thanks to the advanced technology and infrastructure that this award is bringing, the research team can prepare technologically stronger applications to funding agencies for grants for which the team was once not eligible to apply.

The laboratory will also continue to expand its scientific breadth and knowledge base and will actively recruit scientists interested in pursuing answers to major enigmas in heart, lung, and blood vessel diseases. This recruitment will include those with research strengths in genetics, bioinformatics, computational biology, imaging, and pulmonary and cardiovascular specialties. This initiative will help to make St. Paul's, Providence and UBC in general, magnets for young talent in this field.

OUR CURRENT PARTNERS

Canada Foundation for Innovation
British Columbia Knowledge Development Fund (BCKDF)
Providence Health Care, St. Paul's Hospital Site
University of British Columbia
St. Paul's Hospital Foundation
Heart and Stroke Foundation of BC and Yukon
BC Lung Association
GlaxoSmithKline
IBM
Michael Smith Foundation for Health Research (MSFHR)

Contributing to our Future

Funding for infrastructure is difficult to raise. That's why the Canada Foundation for Innovation program is so important for Canadian researchers. However, this initial infusion of infrastructure funding can not be used to maintain a highly technical and expertly staffed laboratory. We must continue efforts to raise funds in the private sector. The St. Paul's Hospital Foundation has been an important partner for all researchers within St. Paul's Hospital. They have been successful in communicating the potential of our research and how it relates to improvement of care.

We continue to encourage corporate, private and individual donors to look into our research and our capabilities with the help of the Foundation. Together, we can offer donors a variety of ways to make concrete and recognized contributions to heart, lung and blood vessel research. Options for donors include (but are not limited to):

- Naming of a specific laboratory or room at iCAPTUR⁴E;
- Naming of a specific piece of equipment such as novel imaging instruments;
- Supporting specific research endeavours such as our precious biological specimen repository;
- Supporting the work of talented young researchers and trainees through a named scholarship or bursary.

Because the iCAPTUR⁴E Centre/MRL represents such a unique passion we want to build on a successful, integrated model of research by attracting like-minded and results-oriented donors. We need donor champions who share in our vision for better heart and lung health. We encourage corporate, private and individual donors to look into our research and our capabilities with the help of the St. Paul's Foundation (604 682 8206/1 800 720 2983) or the UBC Development Office (604 682 8900/1 877 717 GIVE).

From **CURIOSITY**
to **DISCOVERY**

Meet the iCAPTUR⁴E Centre/MRL Researchers

Michael F. Allard, BSc, MD, FRCPC is an investigator with The University of British Columbia's iCAPTUR⁴E Centre/MRL and a cardiovascular pathologist at the St. Paul's Hospital site. Dr. Allard's research examines how the heart uses fuels such as sugar for energy production, how hormones, exercise, and disease alter fuel use by the heart, and how alterations in fuel use influence heart function. A particular focus of his work is to understand specific cellular and molecular mechanisms responsible for alterations in fuel use in these settings, especially in hearts enlarged by exposure to long-standing pressure overload. Ultimately, he hopes to develop novel therapeutic approaches to modulate fuel use by the heart and, thereby, improve heart function. He works closely with Dr. Roger Brownsey in the Department of Biochemistry and Molecular Biology at The University of British Columbia

and with Dr. Gary Lopaschuk in the Departments of Pharmacology and Pediatrics at The University of Alberta. Dr. Allard was awarded a Career Investigator Award from the Heart & Stroke Foundation of B.C. & Yukon for 1999–2004.

Tony Ramon Bai, MD, FRCPC is an investigator with the iCAPTUR⁴E Centre/MRL who trained in Internal Medicine, Physiology, Pharmacology and Respiratory Medicine at The University of Otago in Dunedin, New Zealand, St. Thomas' Hospital in London, England, and McGill University. For more than two decades, he has studied the underlying mechanisms and causes of asthma. He is now investigating the determinants of asthma severity and the role of interactions between the immune system and airway innervation in the expression of the inflammatory response in the lung. Specifically, he

is interested in the interaction of the IL-6 family of cytokines with neurotransmitters, nerves and smooth muscle, the use of non-invasive biomarkers of asthma control and a new therapy for idiopathic pulmonary fibrosis. He collaborates with other members in the pulmonary research group as well as investigators from the UBC Faculty of Pharmaceutical Sciences and Dr. D. Knight at The University of Western Australia.

Del Dorscheid, MD, PhD, FRCPC is a physician-scientist who serves as an intensivist in the ICU at St. Paul's Hospital and leads a research group at the iCAPTUR⁴E Centre/MRL investigating the role of the airway epithelium in the genesis of inflammatory airways diseases. Dr. Dorscheid is now studying the role of glucocorticoid-induced airway epithelial cell apoptosis, novel glycoproteins involved in the repair of injured

epithelium and the expression of Fas ligand as an immune barrier for the airway in changes associated with chronic airways remodeling. Dr. Dorscheid is a past winner of Parker B. Francis Fellowship in Pulmonary Research for his work entitled Glucocorticoid-induced airway epithelial cell apoptosis.

Jiri Frohlich, MD, FRCPC is the Academic Director of the St. Paul's Hospital Healthy Heart Program where he conducts and oversees both basic and clinical research, and an Investigator with the iCAPTUR⁴E Centre/MRL. Dr. Frohlich's specialty is medical biochemistry, a subspecialty of pathology and laboratory medicine. Over the last 25 years, he has extended his specialty into laboratory and clinical aspects of lipoprotein metabolism and atherosclerosis. He now studies dyslipidemias, atherosclerosis, phytosterols

in medicine, genetic determinants of response to inflammation and atherosclerosis and HDL metabolism. Dr. Frohlich collaborates with colleagues at the Czech Academy of Sciences, The University of Hong Kong and The University of Tehran, among other institutions. Dr. Frohlich is also President of British Columbia Healthy Heart Society.

Shizu Hayashi, PhD, a molecular biologist in the iCAPTURE Centre/MRL, trained with Dr. David Suzuki in the Department of Biochemistry at UBC and at The University of Konstanz, Germany. Dr. Hayashi works closely with Drs. James Hogg, Stephan van Eeden and Andrew Sandford in studying the role of adenovirus E1A in the pathogenesis of chronic obstructive pulmonary disease. She also collaborates with Dr. William MacNee, University of Edinburgh, and Dr. Ralph Brattsand, AstraZeneca R&D, Lund, Sweden.

Richard G. Hegele, MD, FRCPC, PhD is an investigator in the iCAPTURE Centre/MRL and an Anatomical Pathologist at St. Paul's Hospital. Dr. Hegele is studying the role of respiratory viral infections in the onset of childhood asthma and allergy, molecular viral diagnosis and animal models of viral lung infections. Over the next few years he will focus on examining the effects of interventions designed to prevent post-bronchiolitis asthma and allergy in children. He collaborates extensively with other UBC scientists as well as with Dr. Giovanni Piedimonte at The University of Miami and Dr. Bruno Battistini at Université Laval, Quebec. Dr. Richard Hegele was recently awarded a BC Lung Association Operating Grant for his work on "Role of RSV in post-bronchiolitis wheezing". He is a BC Lung Association/CIHR New Investigator.

John Hill, BMLSc, MSc, PhD, an investigator with the iCAPTURE Centre/MRL, directs the Atherosclerosis Specialty Laboratory at St. Paul's Hospital, studying lipids and lipoproteins and their relationship with coronary artery disease. Dr. Hill's research has focused on the structure-function relationships of lipolytic enzymes that influence the levels of circulating HDL cholesterol. In the next few years his research will expand to include the analysis of

genetic markers related to the development of coronary artery disease within a variety of patient populations. Several studies analyzing a number of different genes are already underway. He collaborates with Drs. Howard Wong at UCLA—Los Angeles, Zemin Yao at the Ottawa Heart Institute and Pat Eacho of Eli Lilly. This past year Dr. Hill was awarded a Michael Smith Foundation for Health Research Scholar Award.

James Hogg, MD, PhD, FRSC is Professor Emeritus of Pathology at UBC and an investigator in the iCAPTURE Centre/MRL. Dr. Hogg's research focuses on the inflammatory process in the lung with particular reference to the structure and function of the lungs in Chronic Obstructive Pulmonary Disease. On his retirement at the end of 2000, he was honoured by the St. Paul's Hospital Foundation, which established the "Dr. James Hogg Young Scientist Award" in recognition of his leadership and mentorship of many young scientists over a stellar career, including 23 years at St. Paul's. The UBC Department of Pathology and Laboratory Medicine has established a lecture in Dr. Hogg's name held at the annual Pathology Research Day Gala. Dr. Hogg works in collaboration with Drs. Peter Paré, Stephan Van Eeden and Shizu Hayashi. In 2002, Dr. Hogg was awarded the Father Sean O'Sullivan Research Award.

Issy Laher, PhD, a faculty member in Pharmacology and Therapeutics, UBC, and an investigator in the iCAPTURE Centre/MRL, specializes in the pharmacology of autoregulation of blood flow, and autonomic pharmacology of specialized circulations. His interests are in understanding the function of small blood vessels in health and disease, in particular how blood vessel diameter is modified on both a short and long term basis. Dr. Laher was awarded a BC Scholars Award to China Travel Grant for 2001–2002 and is the recipient of a CFI New Opportunities Award.

Bruce McManus, MD, FRCPC, PhD, FCAP, FACC, FCCP is Co-Director of the CFI funded iCAPTURE Centre/MRL, Director of the Cardiovascular Research Laboratory and the Cardiovascular Registry. As Scientific Director of the Institute

of Circulatory and Respiratory Health, one of the Canadian Institutes of Health Research, Dr. McManus leads the development and implementation of a strategic research plan for Canada to address outstanding questions related to cardiac, respiratory, vascular, brain (stroke), blood, critical and intensive care, sleep disorders and diseases. His current research focuses on host and viral genetic determinants of myocardial injury and on the mechanisms of endothelial injury and matrix accumulation in allograft vasculopathy. Dr. McManus is heavily engaged in graduate education, greatly enjoying his six current graduate students. Dr. McManus collaborates with Drs. Yang, Luo, Van Breemen, and Laher in the iCAPTURE Centre, and with investigators like Drs. Michael Hayden and Urs Steinbrecher in the UBC community. He also works extensively with scientists across North America. This past year, Dr. McManus was honoured with the John Foerster Distinguished Lecture Award from the Institute of Cardiovascular Sciences, St. Boniface Hospital and Research Foundation, Winnipeg, Manitoba, and was Honorary Chair for The Cardiovascular System in the Era of Genomics and Proteomics, at The University of Montreal. Dr. McManus and the iCAPTURE team were awarded an additional \$4.6 million from CFI for additional iCAPTURE Centre facility upgrades.

Peter Paré, MD is Director of the McDonald Research Laboratories where he is a full-time scientist, Co-Director of the iCAPTURE Centre and the Director of the Department and Faculty of Medicine Clinical Investigator Programs. Dr. Paré has continued to assist in the advancement of the Michael Smith Foundation for Health Research and was chair of the MSFHR task force on the establishment of an Institutional and Research Unit Infrastructure support program. This past year he was awarded a Michael Smith Foundation for Health Research Distinguished Scholar Award and a Jacob Churg Distinguished Researcher Award. Dr. Paré and his team were also awarded a \$2.7 million CIHR Gene-Environment Grant to study inflammatory gene haplotypes and susceptibility to cardiac, vascular, and pulmonary disease. His research focuses on the genetics and patho-

physiology of asthma and chronic obstructive pulmonary disease. He collaborates with Drs. Bob Schellenberg and Chun Seow in investigating events that relate bronchoconstricting stimuli to the ultimate airway narrowing that occurs. Dr. Paré also collaborates with Drs. Sandford, Bai and J. Hogg and with health economist Dr. Aslam Anis.

Jim Russell, MD, FRCPC, an investigator with the iCAPTURE Centre/MRL, is an intensivist and internist who did his research training at The University of California, San Francisco. Dr. Russell's research has focused on three areas: trials of new therapy for sepsis (severe infection), septic shock and acute lung injury; hypoxia in the critically ill and exercise-induced hypoxia; and the role of genetics of the inflammatory response in the critically ill. He is now leading a CIHR-funded multicentre trial of vasopressin in septic shock, directing research at the only Canadian site in the NIH-funded ARDSnet clinical trial network and preparing to do further training in the genetics of sepsis. His goal is to link the studies of genetics and the inflammatory response to trials of new treatment to determine how genetic makeup affects response to treatment of the critically ill. Dr. Russell also won recognition at the American Thoracic Society for one of only two abstracts in Critical Care that "best represents the focus and quality of research presented at the conference for genetics of septic shock. Dr. Russell collaborates locally with Drs. Keith Walley, Peter Paré, Del Dorscheid, Andrew Sandford and with US investigators at Harvard and UCSF.

Andy Sandford, BSc, PhD earned a doctorate at Oxford University (1993) with a study of the genetic basis of allergic diseases such as asthma. He continues this research at the iCAPTURE Centre/MRL and has broadened his focus to include the genetic basis of cystic fibrosis and chronic obstructive pulmonary disease. Dr. Sandford held a fellowship from the Parker B. Francis Foundation and has been awarded a Tier 2 Canadian Research Chair. He is studying a cohort of infants at high risk for developing allergic diseases and evaluating the importance of genetic risk factors for the development of these diseases.

Dr. Sandford also collaborates in a study of a second cohort of patients, which examines the genetic factors that affect the rate of decline of lung function. He has recently been awarded a grant to study genetic modifiers of pulmonary disease severity in patients who have cystic fibrosis.

Robert Schellenberg, MD, FRCPC is a scientist at the iCAPTUR^{4E} Centre/MRL and an Internist/Allergist at St. Paul's Hospital. Dr. Schellenberg studied at The University of Manitoba and the Johns Hopkins University School of Medicine. His primary interests relate to the role of extracellular matrix changes in modulating airway smooth muscle contraction in asthma and COPD. Recent studies have utilized laser capture microdissection to define specific enzymes from individual cell types present in human airways that are relevant to the maintenance of normal smooth muscle function and its modulation by cytokines involved in allergic inflammation. He collaborates with other members of the MRL, as well as with investigators at The University of Alberta.

Chun Y. Seow, PhD, an investigator with the iCAPTUR^{4E} Centre/MRL, specializes in smooth and skeletal muscle cell physiology. His research focuses on understanding the structure-function relationship in smooth muscles in general and airway smooth muscle in particular. Specifically, he studies changes in ultrastructure of contractile and cytoskeletal filaments and proteins in smooth muscle at different muscle lengths and under physiological/pathological conditions, and correlates these changes to mechanical functions of the cell. His other interests include skeletal muscle mechanics, ATPase cycle associated with the crossbridge cycle in muscle contraction, energetics of muscle contraction, and mathematical modeling of muscle contraction. He received the CIHR/BC Lung Investigator (5 year salary award) in 2001.

John Y.C. Tsang, MD, FRCPC is a specialist in Critical Care Medicine and Anesthesiology, and an investigator at the iCAPTUR^{4E} Centre/MRL. He studies endothelins and their antagonists in the pathogenesis of acute pulmonary embolism, and plans to continue studying endothelin

receptor expression in acute pulmonary embolism. Dr. Tsang collaborates with Dr. Bruno Battistini at Université Laval, Quebec, and Dr. Michael Hlastala at The University of Washington, Seattle.

Cornelis (Casey) van Breemen, DVM, MSc, PhD trained as a veterinarian and pharmacologist and was a faculty member at The University of Miami before returning to Canada to join the iCAPTUR^{4E} Centre/MRL. He is Professor Emeritus at UBC. Interested in the control of blood vessel function in health and disease, Dr. van Breemen uses confocal microscopy combined with measurements of force and membrane currents and potentials to elucidate the mechanisms of intracellular calcium signaling in smooth muscle and endothelial cells. In particular, he is keen to answer two questions: How does one signaling ion, calcium, control a number of separate functions in the same cell; and what are the ionic mechanisms responsible for vascular heterogeneity? He is also interested in relating changes in cell signaling in response to pathological insults to early functional changes in the development of vascular disease. He has delivered numerous invited lectures internationally this past year.

Stephan van Eeden, MD, PhD, FRCPC is a scientist at iCAPTUR^{4E} Centre/MRL and an Internist at St. Paul's Hospital. He did his medical training at The University of Stellenbosch, South Africa, specializing in pulmonology and critical care, and completed his PhD in Experimental Medicine at UBC. Dr van Eeden's research deals with the mechanisms of lung inflammation, particularly, lung inflammation caused by infection, cigarette smoking and air pollution. His current research addresses the response of bone marrow during acute and chronic lung inflammation. He has shown that white cells released from bone marrow play a crucial role in lung inflammation caused by cigarette smoke and particulate air pollution. This research has led to the novel hypothesis that white cells released by the bone marrow are responsible for the increased rates of heart and lung disease and death in subjects exposed to high levels of air pollution. A recent study by Drs. Stephan van Eeden and Jim Hogg released early

this year in the Journal of the American College of Cardiology, is the first to provide a biological explanation to why numerous epidemiological studies have found increased risk of heart disease and stroke from air pollution. In this widely publicized study, air pollution is found to accelerate atherosclerosis — the cause of heart disease and stroke — by two times.

David Walker, PhD is an Associate Professor in the iCAPTUR^{4E} Centre/MRL and the Graduate Advisor for the Department of Pathology and Laboratory Medicine at UBC. A graduate of botany and zoology at The University of California at Santa Barbara and UBC, Dr. Walker's research encompasses three areas: definition of structural and functional aspects of the migratory pathway of leukocytes during inflammatory processes in the lungs and conducting airways; diapedesis to destinations within the interstitium and the airspaces; and the roles of fibroblasts in this process. His current initiatives include a collaborative study with Dr. J.C. Hogg, of the role of alveolar wall fibroblasts in "normal" and emphysematous human lungs in leukocyte migration. He is also working with Drs. A. Burns and C.W. Smith to examine the process of diapedesis across endothelium in vitro and in vivo, and with Professor J. Bert in Chemical Engineering at UBC on a study of the relationship between fibroblasts and their relationship to their extracellular matrix. In collaboration with Dr. Bruce McManus, Dr. Walker is looking at leukocyte interactions with the endothelium in transplant hearts.

Keith R. Walley, MD, FRCPC, ABIM, a St. Paul's Hospital intensivist, is associate director of the iCAPTUR^{4E} Centre/MRL and assistant head of basic research in the St. Paul's Department of Medicine. Dr. Walley's research articulates the mechanisms of decreased left ventricular contractility during sepsis and of other organ dysfunction during sepsis and examines the role of genotype on phenotype in sepsis and systemic inflammatory states. He has shown how to measure left ventricular contractility by using left ventricular pressure-volume relationships in acute animal model experiments. Dr. Walley collaborates extensively with Dr. James Russell in critical care research.

Xiaodong Wang, PhD, an investigator with the iCAPTUR^{4E} Centre/MRL, focuses his research on Ca²⁺ regulation in vascular endothelium. He uses both electrophysiological and Ca²⁺ sensitive fluorescence imaging techniques to study ionic currents and Ca²⁺ regulation in freshly isolated endothelial cells and in disease models for transplant vascular disease. This cellular work is combined with complementary studies on intact blood vessels in an organ bath system, RT-PCR and electron microscopy. Dr. Wang's current projects include the studies of Ca²⁺ extrusion in native and diseased endothelium, effects of oxidative stress and cytokines on Ca²⁺ extrusion and nuclear Ca²⁺, and endothelium derived hyperpolarizing factor (EDHF).

Pearce Wilcox, MD, FRCPC is a clinician-researcher based out of the iCAPTUR^{4E} Centre/MRL. Dr. Wilcox, who completed his research training at The University of British Columbia, is an associate professor in the UBC Faculty of Medicine and teaches extensively on respiratory medicine. Dr. Wilcox's research interests include adult cystic fibrosis, respiratory sleep disorders, respiratory medicine, ventilatory muscle disorders, pathophysiology and treatment, intermittent mechanical ventilation for treatment of chronic hypercapnic respiratory failure, exercise physiology, ventilatory muscle testing, and the effects of sepsis inflammatory mediators on ventilatory muscle.

Decheng Yang, PhD is a molecular virologist in the iCAPTUR^{4E} Centre/MRL, St. Paul's Hospital. He completed his PhD and postdoctoral research at The University of Illinois and is primarily interested in the molecular biology and pathogenesis of viral myocarditis and the development of potential antiviral treatments. Specifically, Dr. Yang is studying the mechanism of coxsackieviral translation initiation and the functional analysis of differentially expressed genes in hearts infected by coxsackievirus. He is an Honorary Professor of Nankai University, People's Republic of China.

iCAPTUR⁴E Centre/MRL: Earned Grants 2001–02

RESEARCHER	\$	DESCRIPTION	FUNDING SOURCE
Allard, Michael	11,638	Glycogen turnover and glycolytic capacity of the hypertrophied heart	H&SFBCY: Research
	29,935	UV/visible spectrophotometer	H&SFBCY: Major Equipment Grant
	93,314	Regulation of carbohydrate oxidation in cardiac hypertrophy	H&SFBCY: Research
	30,000	Cardioprotective effects of trimetazidine in pressure-overload hypertrophied hearts	Institut de Recherches Internationales Servier
	77,889	Glycogen turnover and glycolytic capacity in the hypertrophied heart	CIHR: Operating Grant
	76,050	Regulation of carbohydrate metabolism in cardiac hypertrophy	H&SFBCY: Career Investigator Award
Allard, Michael	\$ 318,826		
Bai, Tony	99,509	A randomized, double-blind, placebo-controlled phase II study of the safety and efficacy of subcutaneous recombinant interferon-γ1b (rIFN-γ 1b) in patients with idiopathic pulmonary fibrosis	Intermune Pharmaceuticals, Inc.
	81,302	Modulation of airway function by neurotrophic cytokines	CIHR: Operating Grant
	29,110	Morphometric characterization of carcinoid tumour associated airways hyperresponsiveness	BC Lung Assn.: Project Grant
Bai, Tony	\$ 209,921		
Dorscheid, Delbert	22,500	Airway permeability in chronic corticosteroid administration to humans	BC Lung Assn.: Project Grant
	47,100	The health benefits of conjugated linoleic acid (CLA) for asthma and allergy	Natural, Inc.
	31,250	Mechanisms of airway epithelium apoptosis	National Heart, Lung and Blood Institute NIH
	84,536	Endothelial FASL/MRL expression and reperfusion injury	H&SFBCY: Research
	93,062	Airway epithelial injury as a result of corticosteroid-induced apoptosis	CIHR: Operating Grant
Dorscheid, Delbert	\$ 278,448		
Frohlich, Jiri	8,143	A multicentre, randomized, double-blind, placebo-controlled study to evaluate the safety and efficacy of SCH-58235 when added to current regimen in patients with homozygous sitosterolemia (Non-U.S.) EZETIMIBE SITOSTEROLEMIA STUDY	Merck Frosst Canada & Co.
	28,498	A multicentre, double-blind, randomized, placebo-controlled study to evaluate lipid-altering efficacy, safety and tolerability of SCH 58235 when added to ongoing therapy with an HMG-CoA reductase inhibitor (statin) with patients primary hypo	Merck Frosst Canada & Co.
	68,500	Predictors of clinical outcomes of coronary atherosclerosis	H&SFBCY: Research
	91,422	Clinical protocol for a double-blind, placebo-controlled, randomized, dose-ranging study of SD-5613 as monotherapy and in combination therapy with Atorvastatin (Assessment of cholesterol reduction by an inhibitor of the Ileal Bile Acid Tran	Searle Canada, Ltd
	7,460	An open-label, multinational, multicenter, extension trial to assess the long-term safety and efficacy of ZD4522 in subjects in ZD4522 clinical trial	AstraZeneca Canada, Inc
	2,420	The heart outcomes prevention evaluation — The ongoing outcomes (HOPE TOO) study	McMaster University
	1,000	Cerivastatin for hyperlipidemia: Ethnicity-efficacy relationships. A multi-center, randomized, double-blind, placebo-controlled, parallel group, forced-titration study of the safety and effectiveness of Cerivastatin versus placebo in Japan	Fournier Pharma
	34,939	An Apolipoprotein — A kinetic study to interpret the differential effects of a treatment with high doses of Simvastatin and Atorvastatin on high density lipoprotein cholesterol on hyperlipoproteinemic patients and normal volunteers	National Heart, Lung and Blood Institute NIH
	58,795	Effective exercise modality to reduce insulin resistance in type 2 Diabetic women	H&SFBCY: Research
		500	Heart & Stroke Foundation of Canada/MRC Doctoral Research Award
Frohlich, Jiri	\$ 301,677		
iCAPTUR⁴E	200,000	(Equipment) The iCAPTUR ⁴ E Centre: Imaging, Cell Analysis and Phenotyping toward understanding (Reparative, Responsive, Remodelling, Recombinant) Events	UBC Blusson Fund
iCAPTUR⁴E	200,000	(Construction) The iCAPTUR ⁴ E Centre: Imaging, Cell Analysis and Phenotyping toward understanding (Reparative, Responsive, Remodelling, Recombinant) Events	CFI: Innovation Projects
iCAPTUR⁴E	100,000	iCAPTUR ⁴ E Installation Matching Funds	H&SFBCY
iCAPTUR⁴E	100,000	iCAPTUR ⁴ E Installation Matching Funds	BC Lung Association
Hayashi, Shizu	20,517	Regulation of transcription factor activation by adenovirus e1a in COPD	BC Lung Assn.: Project Grant
Hayashi, Shizu	\$ 20,517		
Hegele, Richard	22,350	Role of RSV in post-bronchitis wheezing	BC Lung Assn.: Project Grant
	92,825	Lung viruses	CIHR: Operating Grant
	40,950	Viruses and asthma	CIHR/BC Lung Assn: Investigator
Hegele, Richard	\$ 156,125		
Hill, John	63,400	Structure-function relationships of hepatic lipase and lipoprotein lipase	H&SFBCY: Research
Hill, John	\$ 63,400		
Hogg, Jim	98,900	Atmospheric pollution and cardiovascular disease	HC: Toxic Substances Research Initiative
	123,009	Structure and function of pulmonary microvasculature	CIHR: Operating Grant
	69,375	Steroid response and latent adenoviral infection in cigarette smoke-induced emphysema in guinea pigs	CIHR/Canadian Lung Assn: Postdoctoral Fellowship
	174,137	Evaluation for a new treatment for emphysema	Glaxo Wellcome Inc (GlaxoSmithKline)
	48,500	GlaxoSmithKline/Canadian Lung Association/CIHR Research Fellowship	GlaxoSmithKline/Canadian Lung

	42,000	Dr. K.K.Pump Fellowship in Pulmonary Pathology — Drs. Emiko Ogawa and Yasutaka Nakano	Assn/CIHR Fellowship BC Lung Assn.: Fellowship
	375,143	Adenoviral infection in the pathogenesis of emphysema	NIH (US): Research Grant
	15,000	Measurement of lung growth	BC Lung Assn.: Project Grant
	51,185	The systemic inflammatory response induced by air pollution	American Lung Assn.: Career Investigator
	7,894	Retinoids and nicotine: Effects on alveolar development	NIH: National Research Service Award — PD Fellowship
	117,258	Structure and function of the bronchial mucosa	CIHR: Operating Grant
	552,030	Pathologic assessment of lung volume reduction surgery	NIH (US): Research Grant
Hogg, Jim	\$1,674,431		
Laher, Ismail	53,427	Novel pathogenesis and therapies for transplant vascular disease	CIHR: Operating Grant
Laher, Ismail	\$ 53,427		
McManus, Bruce	70,992	Myocyte death in myocarditis: coxsackievirus modification of host cell death machinery	CIHR: Operating Grant
	86,500	Survival signalling in coxsackievirus-induced myocarditis	H&SFBCY: Research
	75,000	Inflammatory cardiovascular diseases	CIHR
	1,000	Cardiac myocyte apoptotic and anti-apoptotic signalling pathways following coxsackievirus B3 infection	MSFHR: Doctoral Trainee Research Award
	1,000	Host cell signalling following coxsackievirus B3 infection: elucidation of anti-apoptotic survival mechanisms	MSFHR: Doctoral Trainee Research Award
	60,300	VEGF in endothelial permeability & cell viability in transplant vascular disease	CIHR: Operating Grant
	24,650	VEGF in endothelial permeability & cell viability in transplant vascular disease	H&SFBCY: Research
	175,000	Signaling in initiation and acceleration of lipid-rich transplant vascular disease	H&SFBCY: Program/Project Grant
McManus, Bruce	\$ 494,442		
Paré, Peter	\$ 31,984	Leukocyte kinetics in the bronchial circulation	CIHR: Operating Grant
	5,000	Cardio-pulmonary-blood and critical care health research (CPBCC) program	CIHR Strategic Training Initiatives in Health Research
	297,575	Remodeling of human airways in disease	NIH (US): Research Grant
	375,293	A two-year, multi-site family study to identify the genetic determinants associated with susceptibility to chronic obstructive pulmonary disease	GlaxoSmithKline
	67,766	Human airway smooth muscle function and bronchial hyper-responsiveness	CIHR: Operating Grant
	64,097	Susceptibility genes for COPD	CIHR: Operating Grant
	84,460	Inflammatory gene haplotypes and susceptibility to cardiac, vascular and pulmonary disease	CIHR: Operating Grant
	18,481	(Equipment) Inflammatory gene haplotypes and susceptibility to cardiac, vascular and pulmonary disease.	CIHR
Paré, Peter	\$ 944,656		
Russell, James	\$ 7,928	A phase three study to determine the efficacy and safety for recombinant human activated protein C in severe sepsis	Eli Lilly Canada Inc.
	26,000	Multicenter, double blind, placebo controlled, randomized, phase 3 study of tifacogen (recombinant tissue factor pathway inhibitor) in severe sepsis	Chiron Corporation
	12,580	A randomized trial of a lung open ventilation strategy in acute lung injury	CIHR
	22,500	Albumin ameliorates the inflammatory response to and organ dysfunction after cardiac surgery especially in patients with TNF, IL1 RA and IL6 polymorphisms	
	113,610	Clinical centers for the clinical network for the treatment of the adult respiratory distress syndrome	NIH (US): Research Grant
	203		Various Sources
	33,053	An open-label study of recombinant human activated protein C in severe sepsis: A phase 3b clinical trial (Protocol F1K-MC-EVBF)	Eli Lilly and Company, US
	593,662	Randomized controlled trial of vasopressin vs norepinephrine in septic shock	CIHR: Clinical Trials
	4,728	Phase 2 study to determine the efficacy and safety of Sivelestat in subjects with acute lung injury	Eli Lilly and Company, US
Russell, James	\$ 814,264		
Sandford, Andrew	68,798	Candidate genes for asthma and atopy in a cohort of at risk infants	Parker B. Francis Fellowship in Pulmonary Research
	100,000	Genetic susceptibility to inflammatory airway disease	Canada Research Chairs
	68,445	Candidate genes for asthma and atopy in a cohort of at risk infants	CIHR: Operating Grant
Sandford, Andrew	\$ 237,243		
Schellenberg, Robert	5,000	A phase 3b, multicenter, randomized, double-blind, parallel-group, placebo-controlled study with a 28 week treatment phase to determine the efficacy, safety and tolerability of subcutaneous omalizumab for the treatment of 12–75 year olds	Novartis Pharmaceuticals Canada, Inc
	28,101	Modulation of basophil and eosinophil functional responses by tissue elements	CIHR: Operating Grant
	7,822	Efficacy and safety of budesonide/formoterol (Symbicort) Turbuhaler as single therapy in patients with mild-moderate asthma. Comparison with Symbicort Turbuhaler and Pulmicort Turbuhaler as maintenance therapy, both completed with Bricanyl	AstraZeneca Canada, Inc
	20,325	Effects of tone on human airway smooth muscle contractile responses: relevance to obstructive lung disease	BC Lung Assn: Project Grant
Schellenberg, Robert	\$ 61,248		

Seow, Chun	64,287	Plasticity in airway smooth muscle	CIHR: Operating Grant
Seow, Chun	\$ 64,287		
Van Eeden, Stephanus	21,000	Bone marrow stimulation and lung emphysema	BC Lung Assn.: Project Grant
	15,000	Bone marrow stimulation induced myocardial injury	SPH Foundation
	21,937	New Investigator Award	CIHR — Scholarship
Van Eeden, Stephanus	\$ 57,937		
Walley, Keith	98,948	Mechanism of myocardial dysfunction during sepsis	H&SFBCY: Research
	31,026	Resuscitation of early septic shock using albumin	Plasma Protein Therapeutics Association
	48,697	Myocardial dysfunction: role of leukocytes	CIHR: Operating Grant
	64,248	Resuscitation of early septic shock using pentaspan	Du Pont Canada, Inc.
Walley, Keith	\$ 242,919		
Van Breemen, Cornelius	52,000	Composite effects of distention and arterial hemodynamics on vein graft failure in a porcine model	H&SFBCY: Research
	89,000	Calcium oscillations in vascular smooth muscle	CIHR: Operating Grant
	15,000	Roles of valvular myofibroblasts and endothelium in the development of human cardiac valvular disease	MSFHR: Doctoral Trainee
Van Breemen, Cornelius	\$ 156,000		
Wilcox, Pearce	8,390	Multiple combination bactericidal antibiotic testing for acute exacerbations of cystic fibrosis associated with multi-resistant burkholderia cepacia, pseudomonas aeruginosa and/or other multi-resistant organism infections	Ottawa Hospital
	3,000	Resource utilization study in COPD (RUSIC) — A prospective study to quantify the effects of COPD exacerbation on the health care resource utilization of COPD patients	Boehringer Ingelheim Ltd.
Wilcox, Pearce	\$ 11,390		
Yang, Decheng	2,106	Mechanisms of tissue tropism of coxsackievirus B3: molecular basis of gene therapy	H&SFBCY: Research
	73,892	Mechanisms of tissue tropism of coxsackievirus B3: Molecular basis for gene therapy	CIHR: Operating Grant
	71,256	Functional analysis of three differentially expressed genes in the coxsackievirus b3-infected heart of transgenic mouse models	CIHR: Operating Grant
Yang, Decheng	\$ 147,254		
iCAPTUR⁴E/MRL TOTAL			
\$6,908,412			

iCAPTUR⁴E — *Imaging, Cell Analysis and Phenotyping toward understanding Reparative, Responsive, Remodelling Recombinant Events*

We encourage corporate, private and individual donors to look into our research and our capabilities with the help of the St. Paul's Hospital Foundation. Together, we can offer donors a variety of ways to make concrete and recognized contributions to the genetic and environmental investigation of heart, lung and blood vessel diseases.

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