

Ontario Consortium for Cardiac Imaging
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TABLE OF CONTENTS

1. Executive Summary
2. Research Highlights
3. Success Stories
4. Schedule A: Milestones and Achievements
5. Schedule C: Deliverables, Performance Measures and Outcomes
6. Appendix I: Award, Patent, Publication and Presentation Lists
7. Appendix II: Workshop Programs
8. Appendix III: Minutes of the Management Board Meetings

1. Executive Summary

In 2004, the Ontario Consortium for Cardiac Imaging (OCCI) continued to do critical work to advance the field of cardiac imaging. Its members developed, and are continuing to develop, collaborations that extend the role of cardiac imaging into new fields. Research highlights from 2004 include substantial advances in the areas of anatomy and function in cardiac development and congenital heart disease; the myocardial characterization of ischemic heart disease (coronary artery disease); imaging for coronaries and intervention; and image fusion, analysis and reporting. Examples from each of these areas are given below.

For example, researchers have made considerable progress in the characterization of cardiac anatomy and physiology, particularly as it applies to children. Studies include characterization of valve pathophysiology, pulmonary hemodynamics, and congenital heart defects. Basic tools for myocardial characterization with positron emission tomography (PET), computed tomography (CT), and magnetic resonance (MR) continue to evolve and are being evaluated in extensive patient studies. New digital X-ray imaging methods for characterizing coronary anatomy and guiding interventions have also been introduced. There have also been new contributions to user interfaces for better visualization and control of MR imaging (MRI) during interventions.

Excitingly, initial results from a major new initiative that is developing imaging tools to guide stem cell therapies suggest a substantial role for nuclear medicine through reporter gene/probe technology and MRI through iron labelling of cells. Many of these efforts are being linked through the development of a software platform for multimodality image visualization and analysis. Furthermore, interactions established through the OCCI have spawned new collaborations in molecular imaging, regenerative medicine, visualization tools for surgery simulation and guidance, and imaging for the treatment of chronic total occlusions.

In 2004, support from the Ontario Research Development Challenge Fund (ORDCF) enabled the OCCI to create 44.5 new jobs in London, Ottawa and Toronto. These new positions included 18.5 research engineers and technicians, 10 postdoctoral and clinical fellows, 15 graduate students and 1 principal investigator. Furthermore, a new laboratory with a 3 Tesla MRI system dedicated solely to research will enable OCCI to hire even more high quality personnel. Graduates supported by the OCCI have accepted offers of employment from institutions in the areas of medical physics, imaging technology and medical research.

In the important area of intellectual property development and technology transfer, members of the OCCI have worked closely with their private-sector partners and have developed new industrial partnerships. New partners joining the OCCI include the Heart & Stroke Foundation, CANAMET Inc. and the St. Joseph's Hospital Foundation. New private- and public-sector funding received in 2004 was over \$10 million. Researchers also filed numerous patents and patent disclosures. Details are in Appendix I.

The OCCI Management Board met three times in 2004 to conduct financial reviews for management of the ORDCF funding, discuss multi-institutional research collaborations and initiatives, and organize the cardiac imaging workshops in London (see Appendix II). OCCI researchers collaborated to form unique multidisciplinary groups to study specific problems in cardiac imaging.

Some of the teams have already submitted grants, successfully as it turns out. Other applications are pending.

Finally, OCCI researchers have had great success communicating their findings to relevant audiences. In addition to publishing 53 peer-reviewed papers and 1 book chapter, scientists have presented 173 lectures, invited talks, conference proceedings and abstracts. The 16th International Workshop on Magnetic Resonance Angiography, sponsored in part by OCCI, was attended by researchers, technicians and students from all over the world. The Web site (www.cardiacimaging.ca), updated with a new look in 2004, promotes cardiac imaging technologies and related research, and associated information and provides links to other portals. It also contains a password-protected “lab book” for researchers to use as a communication tool.

2. Research Highlights

This section highlights some of the notable accomplishments of OCCI that were made possible by funding from ORDCF.

Anatomy and Function in Cardiac Development/Congenital Heart Disease

Christopher Macgowan, PhD & Shi-Joon Yoo, MD – Hospital for Sick Children

With the support of funding from the OCCI, cardiovascular research at the Hospital for Sick Children (HSC) has grown dramatically over the past year. Led by Drs. Macgowan and Yoo, their researchers have become leaders in the application of three-dimensional (3-D) and contrast echocardiography in children. The technology is being used in clinical settings for this population and is improving patient care directly.

The installation last year of a new research MR scanner at HSC has allowed basic scientists (Macgowan group) and clinical scientists (Yoo and Smallhorn groups) to collaborate and expand their research programs, and to recruit new personnel.

Over the past year, Dr. Yoo in collaboration with Dr. Robert Freedom, have advanced their understanding of how congenital heart disease affects blood flow through the lungs. This is an important area of research, because abnormal blood flow reduces the efficiency of oxygen delivery to the body and can increase the workload on the heart. Their work began with the measurement of blood flow in vessels throughout the lungs. Their findings, the first of their kind, have been accepted for publication in *Cardiology in the Young*. The Canadian Institutes of Health Research (CIHR) awarded them a three-year grant to develop these ideas further. They are now studying how congenital heart disease alters the normal flow pattern and how different treatments might return the flow to normal.

Additionally, research teams at HSC and S&W have shown that MR methods for characterizing congenital defects through measurements of blood oxygen state are effective in children. They also have shown feasibility for determining global cardiac function via myocardial oxygen consumption calculated from MR measurements of oxygen, blood flow and tissue volume. Meanwhile, the sensitivity and robustness of oxygen-sensitive imaging are improving through using higher-field

MRI systems and more rapid steady-state methods. These advances hold the promise of extending this effort to regional studies of myocardial function.

Jeffrey Smallhorn, MD – Hospital for Sick Children

Dr. Smallhorn is studying problems with the inflow valves of the heart, which are a major contributor to mortality and morbidity in children with heart disease. Last year, Dr. Smallhorn's team reported on the use of three-dimensional echocardiography (3-D echo) to assess the morphology of inflow valves. This new and exciting technique can detect detailed abnormalities and has already resulted in improved patient care and superior information prior to surgical repair.

This year, Dr. Smallhorn's group has new information on the function of the inflow valves and the importance of their interactions. This, in conjunction with the morphological detail previously acquired by 3-D echo, will allow them to develop a complete understanding of the mechanisms and consequences of inflow valve failure in children. In the future, these applications will allow them to consult with pediatric cardiac surgeons to plan a valve operation before it is started. This technology also has the potential to develop into "reality surgery," where the surgeon plans, carries out and evaluates the surgery on a computer model of the patient's valve.

Derek Boughner, MD and Aaron Fenster, PhD – Robarts Research Institute

Recently, mitral valve repair has become the procedure of choice to avoid prosthetic valve replacement, because it has fewer complications and preserves better ventricular mechanics. However, surgeons and biomedical engineers need a better understanding of the valve structure and its functions in order to simulate the effects of pathological changes and advance the evolution of new medical devices and surgical repair techniques. To address these issues, Drs. Boughner and Fenster are aiming to develop a 3-D computer model of a normally functioning mitral valve in real time (or near real time). This model would incorporate all of the essential anatomic components of the mitral valve: the annulus, anterior and posterior leaflets; the chordae tendineae; and the papillary muscles. Echocardiographic images are to be used as a basis and for comparison of modelled versus measured function. The modeling approach is a three-step development process: First, the underlying topology defining a geometric solid body has been developed using commercial software. Secondly, a physics-based model of the biomechanical properties of the different soft tissues and their interaction has been simulated using the mass-spring modeling technique. Thirdly, static mitral valve models developed by other research groups have been used to validate the functioning 3-D model. Drs. Boughner and Fenster's aim is to create a dynamic computer model that can be interactively modified on the basis of 2-D transesophageal and 3-D transthoracic echocardiographic images, to predict changes in valve function expected to occur due to disease or surgical intervention.

Myocardial Characterization for Ischemic Heart Disease

Rob Beanlands, MD and Rob deKemp, PhD – University of Ottawa Heart Institute

The PARR 2 study, led by Dr. Beanlands, continues. So far, 430 consenting patients have been recruited. Patients were followed-up for at least two years post randomization. Other research projects, under the direction of OCCI investigators or in collaboration with investigators, led by Dr. deKemp, from the University of Ottawa Heart Institute using FDG, NH₃, C-11 acetate and Rb-82

continued. Researchers presented their findings at major scientific sessions (Canadian Cardiovascular Congress, American Society for Nuclear Cardiology and American College of Cardiology). Topics explored in these projects include the following:

- Acute and Chronic Effect of CPAP for Myocardial Efficiency in Patients with Obstructive Sleep Apnea and Heart Failure: A C-11 Acetate study
- The Effect of PRKAG2 Gene Mutation on Myocardial and Skeletal Muscle Glucose Utilization: An FDG PET study
- Stem Cell Mobilization in Post Myocardial Infarction Patients: FDG, NH3 or Rb-82
- Stem Cell Mobilization in Post-Myocardial Infarction Patients undergoing coronary artery bypass grafting: FDG, NH3 or Rb-82
- True or Pseudo Aortic Stenosis: FDG, C-11 acetate
- Rb-NH3 Quantification Comparison Study
- Endothelial Modulation in Angiogenic Therapy: FDG, Rb-82, NH3

Development of [¹¹C]hydroxyephedrine (HED) and rolipram progressed, and human protocols were submitted to the institution's ethics board and Health Canada. Clinical trial applications are pending. Drs. Beanlands and deKemp are also developing new ligands.

In 2003, major advances in quantitative myocardial perfusion measurement (precise measurements of the blood flow through the heart) with PET and CT were reported. Since then, The Rb generator technology transfer was finalized with St. Joseph's in London, Ontario. Katie Lekx was recruited as a multi-institutional postdoctoral fellow in 2004 to transfer this technology from the Ottawa Heart Research Institute to the Lawson Health Research Institute.

Stergios Stergiopoulos, PhD – Lawson Health Research Institute

Since last year's report, Dr. Stergiopoulos has developed a method to minimize motion artifact on CT images of the heart, particularly with lower-end CT scanners. He is preparing to initiate a clinical trial in the People's Republic of China to test his method of cardiac and respiratory gating. Dr. Gerald Wisenberg, another member of OCCI whose research is highlighted below, will review the images that are obtained during this clinical trial.

Gerald Wisenberg, MD – Lawson Health Research Institute

Dr. Wisenberg, with Dr. Frank Prato (his research is highlighted further on), continues to study the kinetics of the MR contrast agent Gd-DTPA for use in assessing the extent of myocardial injury after myocardial infarction (heart attack) in a canine model. In 2004, Dr. Wisenberg and his team did a preliminary clinical study of 9 patients to compare two different methods of contrast administration for infarct assessment. They continue to recruit patients. They are one of the few groups in the world studying the most appropriate way to use contrast agents with MR in detail. By selecting the most appropriate contrast agent, clinicians will be better able to assess myocardial injury and thus improve treatment outcomes.

Ting-Yim Lee, PhD – Lawson Health Research Institute

Dr. Lee has continued his development work of CT perfusion in the quantitative assessment of myocardial perfusion. Drs. Prato and Wisenberg are working with Dr. Lee to use multi-slice CT to obtain images that will provide data on myocardial perfusion, blood transit time, cell membrane integrity and coronary artery anatomy. So far, the methods have been validated in an animal model, and they have started a pilot clinical study with patients. They have been able to measure myocardial blood flow quantitatively; these measures correlate well with the degree of coronary artery stenosis as measured by invasive coronary angiography. Cell membrane integrity is impaired in the setting of a myocardial infarction, and their images have shown relatively small subendocardial myocardial infarctions not detectable by other imaging methods, except perhaps MR. Noninvasive coronary angiography can also be obtained with multi-slice CT, with the measurement of the degree of stenosis hindered only by the presence of calcium in arterial plaques.

Other highlights of Dr. Lee's research over the past years include these:

- In collaboration with scientists from Applied Sciences Lab, General Electric Healthcare, his group has created and tested a beam-hardening correction algorithm for myocardial perfusion measurement with CT.
- He has extended coverage of the myocardial perfusion scanning protocol from the original 2 cm to include the whole heart by using a series of CT angiography images instead of cine scanning.
- He also developed the corresponding tracer kinetics theory for the whole heart scanning protocol.
- Based on the developed tracer kinetics theory, his team developed a computer algorithm to derive the myocardial flow extraction product, vascular blood volume and distribution volume from data obtained with the whole heart protocol.
- His team did computer simulations to show the validity of the computer algorithm.
- He is developing a new algorithm to linearize the kinetics model corresponding to the whole heart protocol. This will speed up the algorithm considerably.
- He has started a pilot study to compare catheter-based angiogram assessment of coronary stenosis with myocardial perfusion as measured by CT Perfusion. Initial results show that the CT measurements are correlated with angiogram results.

After the installation of a 64-slice CT scanner, which is pending, Dr. Lee's team will endeavour to improve the speed of obtaining images and their accuracy in terms of quantitation of flow and the quality of the coronary angiographic images.

Dr. Lee and General Electric Healthcare have started to negotiate for the licensing of the whole heart protocol and its associated tracer kinetics model and computer algorithm, which is being marketed as CT Perfusion Version 4. This novel machine can be thought of as a "one-stop-shop" for the evaluation of ischemic heart disease (coronary heart disease). It provides anatomical, mechanical, perfusion and metabolic information in one study (versus the four separate studies that normally are required) on a PET/CT hybrid scanner. Lawson is the only development site for this equipment.

Additionally, clinical trials have begun using the software developed at Lawson for measuring perfusion in the smallest blood vessels of the heart, or the microvasculature. Preliminary results are positive. In particular, clinicians appreciate the ability not only to visualize the microvasculature of

the heart, but also to measure its activity quantitatively. Such characterizations are valuable in the treatment of ischemic heart disease.

Brian Rutt, PhD – Robarts Research Institute

Since the report last year, Dr. Rutt's group has designed, built and installed insertable gradient coils at three locations: Stanford Research Institute, Albany Medical Center and Robarts Research Institute. Results of a study on a new invention (an MRI pulse sequence concept) that efficiently yields quantitative T1 and T2 values at high resolution and in three dimensions were published in multiple journals in 2004. (The patent disclosure was filed in 2003.) This invention, produced by the world-class multidisciplinary team assembled at Robarts Research Institute, could yield efficient tissue characterization and quantification of MR contrast agent concentrations with MRI.

Imaging for Coronaries/Intervention

John Rowlands, PhD - Sunnybrook and Women's Research Institute

The research program of Dr. Rowlands and his group is central to developments in cardiac catheterization – the main method to diagnose and treat coronary artery disease. Recent developments have made flat panel imagers an optimum approach for cardiac cineangiography. However, although the same detectors are starting to be used for cardiac fluoroscopy, existing flat panel systems are not optimal for this purpose. It is evident from both the work performed here and the literature that all existing flat panel designs are not optimal for cardiac fluoroscopic imaging, because of an excessive electronic noise that prevents the device from being quantum noise limited at the low-exposure levels needed. The broad question Dr. Rowland's team is investigating is if optimal dynamic detectors with low exposure per frame can be developed by incrementally improving existing designs (first-generation flat panel imagers), or if radical design changes or even entirely new designs (second-generation flat panel imagers) are needed. The overall goal of the research program is to determine the optimum commercial approach to dynamic imaging using flat panel imagers. Several second-generation detector design concepts are being investigated using a combination of experimental and theoretical approaches.

Dr. Rowland's team also demonstrated this past year that second-generation indirect-conversion devices using avalanche multiplication and readout using FEA (field-emitter arrays) are worthy of and ready for commercial development. A multinational scientific team consisting of Dr. Kenkichi Tanioka of NHK Science and Technical Research Laboratories, Japan; Drs. Geordi Pang and John Rowlands of Sunnybrook & Women's Research Institute, Canada; and Dr. Wei Zhao of SUNY Stony Brook, USA was assembled to address this question.

Graham Wright, PhD – Sunnybrook & Women's Research Institute

Dr. Wright's group has invented and prototyped a 6 degree-of-freedom (DOF) device known as the Navigator, which is a combined input and output device. They were motivated by visualization and control challenges with emerging real-time interactive MRI techniques. The Navigator is a mechanical armature that has 6 sequential rotational joints that can either be manually positioned by a person or automatically moved by a computer to any position and orientation and can maintain its position when not supported by someone's hand. This device was initially targeted as a user-input

device for MRI. The robotic arm provides a significant improvement in this area by providing both intuitive input and output capabilities. In input mode, the position of the arm controls the current imaging plane of the MR scanner. In output mode, the arm will automatically move to the current imaging plane. It is designed to make it more efficient for a technologist to do an MRI study, thereby resulting in faster, and therefore cheaper, studies. It also allows one to navigate more easily through a set of 3-D images in real-time MRI scan plane prescription and volume image visualization, which may allow for better diagnoses of disease. This device may be critical to the acquisition of transient clinical data in cardiac assessment and to dynamic visualization for MR-guided interventions. It was the subject of a patent disclosure (Dr. Dingrong Yi, a postdoctoral fellow in Dr. Wright's group) and a successful CIHR proof-of-principle grant in 2004.

Frank Prato, PhD – Lawson Health Research Institute

Dr. Prato is leading an ambitious project with a newly formed group to assess the role of bone-marrow-derived stem cell transplantation to regenerate damaged or destroyed heart tissue, thereby limiting the extent of myocardial scarring and fibrosis following myocardial infarction. They are intensively studying the use of reporter probe technology to allow them to determine not only the success of engraftment, but also the ability of transplanted cells to differentiate into cardiomyocytes (the muscle cells of heart muscle tissue). This method involves the transfection of either a viral or plasmid vector, genetically engineered to specifically augment a particular metabolic pathway that will enhance the uptake of a radioactively administered substrate. The genetic programming can be designed to trigger the enhanced uptake only when the cell has differentiated into a cardiomyocyte or endothelial cell. They aim to develop a variety of methods to assess the success of stem cell transplantation using a combination of MR, single photon emission computed tomography (SPECT) and PET imaging. Dr. Glenn Wells, an OCCI investigator at Lawson and colleague of Drs. Prato and Wright, is focusing on the development of nuclear-medicine-based imaging (SPECT and PET) for cell tracking, quantification and the probing of cell function.

Michael Kovacs, PhD – Lawson Health Research Institute

In 2004, Dr. Kovacs and stem cell biologists at Lawson Health Research Institute have successfully introduced genes into bone marrow stem cells so that they can be followed using nuclear medicine imaging methods. These methods might be able to show the functional role of the labelled cells, information that is critical to the development of this new field. In 2004, improving on a previously published method, Dr. Kovacs developed the reporter probe [¹³¹I]FIAU. He found it to be significantly better than previous models with significantly less radioactivity. The work will be transferred soon to the new radiochemistry laboratories at St. Joseph's Health Centre in London, Ontario, which will add increased flexibility to use ¹²³I or ¹²⁴I labels if deemed necessary. The findings were presented at the Society of Nuclear Medicine and the Society for Molecular Imaging in 2004, and Dr. Kovacs is preparing manuscripts for submission to journals.

Maria Drangova, PhD – Robarts Research Institute

In 2004, Dr. Drangova developed methods for image registration of 2-D and 3-D cardiac images for application during interventional procedures. She also developed and evaluated methods to measure motion in 3-D. These will be applied to the heart with the aim of presenting 3-D images, registered to the patient's anatomy, to the interventionalist during procedures. Progress also included making and testing techniques to facilitate the generation of 3-D X-ray coronary angiograms. Combined,

these developments will ultimately have tremendous impact on the delivery of minimally invasive therapies for cardiac disease under MRI guidance combined with multimodality images of the same patient.

Image Fusion, Analysis and Reporting

Perry Radau, PhD – OCCI Technical Office

Headed by Dr. Radau, the OCCI technical office has developed image-viewing software that is ideally suited for multimodality image fusion and analysis. The office has also created a prototype for real-time MR visualization. It has explored the challenges for a multi-institute image database and networking techniques. A software platform named the OCCIviewer was developed to provide a means for multimodality image fusion and analysis. Tools for visualization of surfaces and multiple image planes are available for researchers, as well as statistical analysis of regions of interest. The open architecture of the tool permits researchers to develop further specialized tools and insert them into the framework to extend an already powerful application.

An example of the extension of the OCCIviewer for collaborative research was the development of a 3-D angiography reconstruction plug-in that is based on the research at the Ottawa Heart Institute and Robarts Research Institute. The plug-in provides a streamlined interface to the reconstruction engine and eliminates a costly, computationally inefficient commercial toolbox that has hindered testing and collaboration. Multidisciplinary research involving the collaboration of several institutes has benefited from the ongoing software development of the OCCI technical office. Grant applications for image-guided stem cell delivery were supported by our development of visualization and fusion software. A crucial aspect of the ability of stem cell therapies to revive heart muscle is the localization of the delivery catheter tip close to the injured yet viable tissue. Three-dimensional catheter targeting and visualization techniques have been developed to support successful MRI-guided real-time navigation to the target. In addition, it is important to co-localize damaged regions visualized by several modalities: anatomically with MRI and functionally with nuclear medicine images demonstrating an oxygen-deprived heart muscle. These may also be co-localized with the stem cells that have been labeled with radioactivity and imaged. The image fusion provided by the technical office's software will be a valuable aid in assessing the delivery success and long-term viability of the stem cell procedures.

Real-time MRI acquires a stream of images that are used to guide interventional procedures. Visualization and localization of features present challenges because 2-D images provide limited spatial context. The technical office has developed real-time visualization software that matches a prior, high-resolution 3-D image of the patient's myocardium with the real-time, 2-D images. The alignment of the prior image to the real-time images uses ECG data to synchronize myocardial phase and scanner geometry information. An additional correction for patient motion is being investigated by applying a registration algorithm to match the scan plane to the prior volume. This task is limited by computational speed, and therefore will be augmented by current research to apply computer vision tracking methods that can operate at high frame rates. Investigators at Sunnybrook & Women's Research Institute and Robarts Research Institute are developing real-time MRI and would benefit from this real-time visualization software. Rapid and efficient prototyping of the real-time viewer was realized by leveraging the software libraries developed for the OCCIviewer platform.

In summary, the technical office has addressed many of the common needs of the OCCI by analyzing image-processing requirements and developing general-purpose and specialized software solutions in a manner that is very efficient compared with the traditionally fragmented efforts of isolated researchers.

Derek Boughner, MD and Aaron Fenster, PhD – Robarts Research Institute

Over the past year, Drs. Derek Boughner and Aaron have focused on the development and testing of segmentation software for use with 3-D and 4-D echocardiographic images. Specifically, the team extended its 3-D ultrasound software environment to manual and semi-automated cardiac segmentation applications. The manual segmentation approach involves the capability of identifying the axis of the structure to be segmented, then orienting the 3-D image so that the slicing plane is orthogonal to the axis. Then, the user chooses an inter-slice step, which is used to slice the 3-D image. The structure revealed in that exposed plane is then segmented manually with a computer-driven cursor. The semi-automated segmentation software uses the axis of the structure to be segmented as a rotational slicing axis. The structure is then sliced, and the structure is segmented using an active contour approach. The resulting boundary is automatically copied to the next slice and the process is repeated until the structure is completely segmented. This approach has been used to segment the left atrial appendage as well as coronary vessels from 3-D intravascular ultrasound (IVUS) images. The latter approach was published in *Ultrasound in Medicine and Biology* in January 2005.

3. Success Stories

Governor General's Gold Medal for Scholastic Achievement

In our report for 2003, we highlighted the hiring of Dr. Lukasz Brzozowski, a research associate at Sunnybrook and Women's Research Institute. In 2004, he was awarded the prestigious Governor General's Gold Medal for his doctoral thesis. His doctoral research has resulted in 31 peer-reviewed publications, many presentations and invited talks, a book chapter, co-supervised undergraduate and graduate theses, and two patents sponsored by Nortel Networks. As of August 2004, 80 articles in peer-reviewed journals had cited papers Dr. Brzozowski authored while a doctoral student. Now working with Dr. John Rowlands, a senior scientist in imaging research, Dr. Brzozowski is applying his skills to several projects in multimodality medical imaging.

OCCI Grants Investigator Status

In January 2005, the Management Board approved requests for status as principal investigators in the OCCI. The researchers listed below were granted such status.

Ben Chow, MD, University of Ottawa Heart Institute

A cardiologist at the University of Ottawa Heart Institute, Dr. Chow's area of interest focuses on cardiac imaging. His previous research projects have investigated myocardial perfusion with both PET and SPECT imaging tracers, and he is interested in the prognostic aspects of cardiac PET

imaging. More recently, he has turned to investigations of CT angiography. He is keenly interested in the potential of fusion technology between CT angiography and PET.

Jean DaSilva, PhD, University of Ottawa Heart Institute

Dr. DaSilva is responsible for the development of conventional and novel PET radiotracers for clinical and basic research, including all PET-related OCCI projects. His group works on various projects using radioligands for measuring blood flow, metabolism and neurohormonal pathways in cardiovascular disorders. He is evaluating the pharmacological binding profile of novel tracers in vitro and in vivo to assess their potential as quantitative markers. The aim is to develop and evaluate these probes for imaging altered systems to provide insight into cardiovascular pathophysiology, help direct therapy, and evaluate the progression of disease and treatment using PET.

Alexander Dick, MD, Sunnybrook and Women's Research Institute

Dr. Dick was recruited as a clinical researcher from a research fellowship at the NIH in July 2003. Since joining the OCCI, he has taken a leadership role in the effort to develop a program that applies imaging to cardiac intervention. A particular focus of his research is MRI guidance of cardiac regenerative therapies with stem cells.

Aaron Fenster, PhD, Robarts Research Institute

Dr. Fenster is a world leader in the area of 3-D ultrasound. Specifically related to the heart, he is working on 4-D cardiac imaging using transesophageal and transthoracic echocardiographic techniques, as well as techniques for 3-D intravascular coronary ultrasound imaging. His work in image segmentation and plaque characterization will also be applicable to IVUS images of the coronary arteries.

Michael Kovacs, PhD, Lawson Health Research Institute

Dr. Kovacs is a radiochemist experienced in preparing radio-reporter probes for SPECT and PET imaging and the production of PET radionuclide. His doctorate is in PET radiochemistry, and he did an industrial postdoctoral degree in the area of medical cyclotrons. Since joining the cardiac research program at Lawson, he has developed one reporter probe for cardiac work (^{131}I FIAU), is assisting with the supervision of the ^{82}Ru generator and is gearing up to produce ^{18}F reporter probes for OCCI's cardiac stem cell work.

Christopher Macgowan, PhD, Hospital for Sick Children

Dr. Macgowan studies blood flow and its relation to vascular development and function, in particular, the pulmonary blood flow as a means of studying cardiopulmonary disorders. Since his arrival at the Hospital for Sick Children in 2000, he has developed new noninvasive methods to study blood flow using MR. He then translated these methods to the clinical investigation of cardiovascular diseases, having engineered tools to facilitate the application of these methods.

Anne Martel, PhD, Sunnybrook and Women's Research Institute

Dr. Martel, recruited in 2003 to SWRI from Queen's Hospital in Nottingham, England, is analyzing dynamic contrast-enhanced images using multivariate techniques, particularly multi-spectral tissue characterization and time-series analysis for characterization of perfusion and hemodynamics. She has already been active in the OCCI in the development of modules for the OCCI viewer, and she plans to extend her analysis work to the study of cardiac perfusion.

Gerald Moran, PhD, McMaster University

Since completing his postdoctoral fellowship under Dr. Prato, Dr. Moran has been working with colleagues at McMaster University to use latent variable techniques to use the dynamic information in a series of cardiac MR images better. He has also been building electric impedance tomography (EIT) and current density imaging (CDI) prototypes to assess myocardial damage (on their own and with MRI).

Terry Peters, PhD, Robarts Research Institute

Dr. Peters has built an extensive program at the Robarts Research Institute in developing techniques for minimally invasive cardiac therapy, since he moved there from McGill University in 1997. He supervises a number of students in this area; this work is supported by The Heart and Stroke Foundation.

Robert Stodilka, PhD, Lawson Health Research Institute

Dr. Stodilka was recruited in July 2004 to the Lawson Health Research Institute. His major focus is in the area of SPECT cardiology. He is striving to localize and detect the function of stem cells that have been autologously transplanted into infarcted tissue for myocardial regeneration.

Marshall Sussman, PhD, University Health Network

Dr. Sussman is helping to develop novel and innovative approaches to solving the problem of motion in cardiac imaging. He is using two different strategies – motion compensation and real-time imaging. His work has resulted in a number of valuable advances including image-based motion characterization and correction (self-navigation) with application to cardiac MRI areas such as coronary artery visualization, wall motion analysis and tissue characterization.

Recruitment of Highly Qualified Personnel

Recruitment of Robert Stodilka as a Principal Investigator to Lawson Health Research Institute

In 2004, Dr. Stodilka was successfully recruited to the Lawson Health Research Institute from Medical Imaging Systems Inc. Dr. Stodilka was a graduate student of Drs. Brad J. Kemp and Prato from 1995 to 1999. He completed his postdoctoral fellowship at the University of Massachusetts Medical School working on Gamma-camera PET. He brings with him experience as a defence scientist from the National Department of Defence and as a research scientist from the private sector.

Dr. Stodilka is using nuclear medicine to evaluate stem cell therapy for myocardial infarction. He is focusing on simultaneously localizing and detecting the function of cells that have been autologously transplanted into infarcted tissue. Over the long term, he plans to use SPECT to optimize cell populations and the route and timing of cell delivery; and to monitor the progress of infarct reduction.

Intellectual Property Development/Technology Transfer

We reported in 2003 that Dr. Stergiopoulos, in conjunction with Defence R&D Canada, developed an integrated set of robust and field-deployable noninvasive 3-D/4-D medical imaging and

monitoring vital signs devices that are characterized by high-image resolution capabilities. The devices are not susceptible to motion-related distortion effects, and can operate in noise- and vibration-intense environments. As a result, CANAMET, or Canadian National Medical Technologies Inc., was formed to commercialize this technology.

CANAMET Inc. is celebrating its first year of business with the United States Food and Drug Administration's approval of its first product, the Piesometer Mk-1 automated ambulatory blood pressure monitoring system. Over 400 units have been sold to distributors in Taiwan and China worth \$255,000 (US) in revenue.

Additionally, scientists at Lawson Research Institute have capitalized on efforts at the Ottawa Heart Research Institute to study and analyze in detail the Rb infuser technology initially developed at Ottawa. They recently constructed a second generator and will start canine experiments soon. This collaboration has been greatly enhanced through the OCCI multi-institutional research program. This program has funded a postdoctoral fellow, Katie Lekx, which allows her to concentrate on the transfer of technology from Ottawa to Lawson.

Scientists in OCCI have filed 4 patents and 9 patent disclosures in the past year, covering a diverse range of research areas. Please see Appendix I for a complete listing.

Laboratory Development

The Ivey Centre for Cardiovascular Imaging at Robarts Research Institute opened in September 2004. The 3 Tesla MRI system is the hub of the Centre and is dedicated solely to research. This unique facility will greatly accelerate the work funded by ORDCF and will serve as an unparalleled training site for graduate students working in the program. Staff and research collaborators in OCCI will enjoy full access to the facility and MR system.

Looking ahead, the next phase of growth of this research program at Robarts will include hiring new staff. Having the facility in the lab will allow them to increase substantially of its recruitment of high-quality personnel. These new hires will comprise staff to manage, service and support this facility; and technical staff, graduate students and postdoctoral fellows to work on specific research projects in OCCI.

Collaboration

Members of OCCI have created a multidisciplinary group comprising Drs. Peter Merrifield and Margaret Hough, who are stem cell scientists; Dr. Duncan Stewart, an expert in myocardial gene therapy; Drs. Alexander Dick and Gerald Wisenberg, clinical scientists in myocardial imaging; and Drs. Glenn Wells, Frank Prato and Graham Wright, imaging scientists. By combining expertise in these fundamental, related areas, this group of top-tier scientists will collaborate on two major barriers in achieving stem cell therapy. In vivo non-invasive molecular and cellular imaging methods will be developed to track transplanted cells and their progeny from initial transplantation to engraftment and to new functional tissue formation. With these technologies in hand, the second objective is to evaluate the optimal stem cell transplantation methods including, but not limited to, identification of the optimal cell fraction to be used; delivery methods; location; and timing in

relation to infarct. The findings of this group will place Ontario at the leading edge of research in this area. The implications are huge: This research might be able to reduce the high death rates of patients who have significant heart dysfunction after a heart attack.

Members of OCCI, led by Dr. Graham Wright, have also formed a new collaboration to focus on imaging for chronic total occlusions. Co-investigators are Drs. Lukasz Brzozowski, Peter Burns, Stuart Foster, John Rowlands and Alex Vitkin, who are imaging scientists; Dr. Myron Cybulsky, a biologist; Drs. Alexander Dick and Bradley Strauss, cardiologists; Dr. Jagdish Butany, a pathologist; and Dr. Alan Moody, a radiologist. Expanding on discussions from the 2004 INO symposium, this broad team effort covering X-ray, CT, MR, ultrasound and optical imaging techniques has resulted in the development of new tools for guiding interventions to traverse vascular occlusions. The foundation for this initiative was a successful CIHR proof-of-principal application (awarded to Drs. Wright and Dick) and the patent disclosure filed in 2004 (by Kevin Anderson, a graduate student, and Dr. Wright) on catheter tracking.

Dr. Terry Peters of the Robarts Research Institute has also spearheaded a collaborative project since last year's report. The unique aspects of this project lie in the development of models, which are based on dynamic images of the patient, which allow the surgical environment to be simulated realistically to allow accurate planning and guidance of minimally invasive cardiac procedures. This project is a unique application of image-guidance technologies to a revolutionary approach to coronary heart disease therapy. It is being pioneered in London at the London Health Sciences Centre; the Canadian Surgical Technologies and Advanced Robotics (CSTAR) center in the Lawson Health Research Institute; and the Virtual Augmentation and Simulation for Surgery and Therapy (VASST) laboratory at Robarts Research Institute. The collaboration between the RRI/CSTAR group with OCCI is an unparalleled combination of resources and research expertise in this area.

OCCI funding has led to considerably improved research capacity and expertise at Robarts Research Institute. Dr. Brian Rutt has formed a new multidisciplinary team of four principal investigators from London (led by Dr. Rutt) and five principal investigators from Harvard University (led by Dr. Ralph Weissleder). The team was awarded \$2.3 million (US) in funding through a special strategic initiative jointly sponsored by the US National Institutes of Health and CIHR. During the four years the grant covers, the team aims to develop a radically new form of MRI that can make selective images of a dangerous component of atherosclerotic plaque. If successful, this new form of molecular MRI will open up an entirely new capability for "sensing" specific molecules within tissues completely noninvasively.

Finally, the OCCI contributed \$10,000 toward the 16th International Workshop on Magnetic Resonance Angiography (MRA) and sponsored workshops on cardiac and interventional MRI. (See Appendix II for program.) The MRA Workshop provided an important forum for researchers to highlight their work to private-sector partners. Additionally, corporate sponsors were afforded speaking opportunities. Previously, the MRA Workshop has been hosted at international locations, from the United States to Europe to Asia. For the first time in its 15 years of existence, Canada was the host country. The meeting was attended by about 300 of the leading clinical and scientific researchers, technicians and students working in the area of MR. About 40% of the attendees were from outside Canada. They came from all over, including Norway, France, Netherlands, Sweden, Germany, Austria, Switzerland, South Korea, Korea, USA, England, Japan and Spain.

4. Schedule A: Milestones and Achievements for Year 4

Milestones	Goals	Outcome
Governance	<ul style="list-style-type: none"> • 3 Board meetings per year, including annual meeting with reports to full membership 	<p>The OCCI Board met 3 times in 2004 to update, discuss and/or resolve the following matters:</p> <ul style="list-style-type: none"> • Policies in managing ORDCF payment cash flow and related financial reviews. • Planning for the annual symposium and the annual meeting. • Multi-institutional projects and staff recruitment, selection and project reviews. • New hire targets and updates. • Design and update of Web site. • Board membership. • Disbursement of the Research Performance Fund.
	<ul style="list-style-type: none"> • Ongoing policy evaluation and redevelopment to improve operations 	<ul style="list-style-type: none"> • Policies have been implemented for tighter financial control.
Communication/Collaborations	<ul style="list-style-type: none"> • Scientific symposium plus 3 workshops per year. 	<ul style="list-style-type: none"> • 2004 Annual INO Symposium held in Toronto March 3–5, 2004. • Supported 2 scientific sessions (coronary and interventional MRA), held in conjunction with the MR Angiography Workshop 2004, in London, ON (October 6, 2004).
	<ul style="list-style-type: none"> • Organize an international scientific conference in Ontario. 	<ul style="list-style-type: none"> • Participants in the MR Angiography Workshop had more than 300 scientists, postdoctoral fellows and students from Canada, US and Europe.
	<ul style="list-style-type: none"> • Collaborative studies involving more than one PI and more than one imaging modality within the consortium. 	<ul style="list-style-type: none"> • Funding provided to support 2 multi-institutional research applications for work on collaborate projects within member institutions of the consortium.
Administration	<ul style="list-style-type: none"> • Complete audit as required. 	<ul style="list-style-type: none"> • Completed a third party audit, as required.
	<ul style="list-style-type: none"> • Meet quarterly budgeting and financing targets, including collection of industrial contributions and planned spending. 	<ul style="list-style-type: none"> • Ongoing filing of Schedule E.

Milestones	Goals	Outcome
	<ul style="list-style-type: none"> • Maintain Web documentation of scientific progress. 	<ul style="list-style-type: none"> • Introduced new design, ongoing update and maintenance of OCCI Web site.
Recruitment and development of scientific personnel	<ul style="list-style-type: none"> • Expansion of academic credentials (publications, grants, presentations, awards) of scientific personnel, particularly new faculty. 	<ul style="list-style-type: none"> • See Appendix I for details.
	<ul style="list-style-type: none"> • Ongoing hiring based on needs. 	<ul style="list-style-type: none"> • Ongoing.
Training	<ul style="list-style-type: none"> • Increase training positions commensurate with development of research capacity. 	<ul style="list-style-type: none"> • 15 new graduate students and 10 postdoctoral and clinical fellows were brought into the program in 2004.
	<ul style="list-style-type: none"> • Ongoing recruitment and training of individuals. 	<ul style="list-style-type: none"> • Ongoing.
	<ul style="list-style-type: none"> • Track those receiving training in multiple modalities and working with multiple investigators. 	<ul style="list-style-type: none"> • Labonny Biswas and Katie Lekx (Multi-Institutional Research Positions).
Laboratory development	<ul style="list-style-type: none"> • Purchase of equipment as identified in budget. 	<ul style="list-style-type: none"> • Ongoing as planned.
	<ul style="list-style-type: none"> • Ongoing upgrades of research equipment to maintain state-of-the-art. 	<ul style="list-style-type: none"> • Ongoing as planned.
	<ul style="list-style-type: none"> • Prototype hardware development. 	<ul style="list-style-type: none"> • Ongoing as planned. Please see previous section on CT 4 Perfusion Workstation. • Substantial progress in understanding the physiological limitation of high performance gradient coils in human MRI studies. (RRI)
Scientific advances in research projects	<ul style="list-style-type: none"> • Increased application of new methods in patient studies. 	<ul style="list-style-type: none"> • MR assessment of patients with pulmonary blood flow disturbance. (HSC) • Evaluation of MR oximetry in pediatric patients. (SWRI & HSC) • Clinical trial for thrombolyn application. (LHRI)

Milestones	Goals	Outcome
	<ul style="list-style-type: none"> Expansion of physiological measurements; move toward accurate, absolute quantification of parameters. 	<ul style="list-style-type: none"> Publication of validation of real-time MR velocity measurement vs. ultrasound and phase-contrast MRI. (HSC) Optimized contrast-enhanced MRA timing parameters in children with congenital heart defects. (HSC) Ongoing studies of myocardial viability; collaborative discussion of animal model with Katie Lekx. (SWRI with LHRI & UOHI) Demonstration of measures of myocardial oxygen consumption. (SWRI) New fast oxygen-sensitive MR methods developed (SSFP). (SWRI)
	<ul style="list-style-type: none"> Testing of new imaging hardware, associated patient monitoring and life support systems, and molecular imaging agents. 	<ul style="list-style-type: none"> Evaluation of MR Echo, latest GE product for real-time cardiac imaging, and Vector Cardiographic Gating (VCG). (HSC) In conjunction with CANAMET, a low cost heart monitor has been developed and is being sold. (LHRI) 1.5T CV/I MR scanner located at LHSC upgraded to the Excite platform (4 channels up to 8 channels). (RRI) 1.5T MR upgraded to the Excite platform (4 channels up to 8 channels). SWRI MR labelling of cells in anticipation of cell-based therapies. (SWRI) Determined advantages mechanism for and disadvantages of avalanche multiplication for fluoroscopy and cine for cardiac angiography. (SWRI) Investigated high dynamic range pixel architectures for diagnostic medical imaging. (SWRI) Determined imaging properties of amorphous selenium and cesium iodide scintillators for use in cardiac x-ray imaging. (SWRI)

Milestones	Goals	Outcome
	<ul style="list-style-type: none"> Increasing speed and accuracy imaging information fusion across modalities - application to myocardium, coronary arteries, anatomical assessment. 	<ul style="list-style-type: none"> Development of techniques for using hybrid PET/CT for cardiac attenuation correction to improve accuracy of PET quantitation. (LHRI) New visualization (real time embedded in prior 3D MR data set) and control (6D of Navigator) tools developed and presented at various conferences; patent filed on 6D of Navigator. (SWRI) Algorithms developed for image alignment in the OCCViewer. Visualization tools for comparing image modalities. (SWRI)
	<ul style="list-style-type: none"> Integration of multiple analysis tools on single platform. 	<ul style="list-style-type: none"> Real-time interface to MR scanner developed further to allow data processing and visualization. (HSC) Investigation of combination of x-ray imaging and MRI on the same system. (SWRI) Development of freely available, open-source OCCViewer. (SWRI)
	<ul style="list-style-type: none"> Linkage of databases across multiple institutions 	<ul style="list-style-type: none"> Created Web site for source-revision control (CVS) and bug tracking (Bugzilla) for real-time development platform. (HSC)
	<ul style="list-style-type: none"> Comparison of anatomic and physiological information across modalities; ongoing evolution of protocols for disease assessment and intervention monitoring. 	<ul style="list-style-type: none"> Validation of real-time MR velocity measurement vs. ultrasound and phase-contrast MRI. MRI flow data and x-ray angiographic features of collateral circulation compared. (HSC) PET/CT and PET/MRI - registering images between PET/CT/SPECT/MRI. (LHRI) New method to track catheters (patent filed). (SWRI)

Milestones	Goals	Outcome
	<ul style="list-style-type: none"> Ongoing development of mathematical models relating image signal behaviour to underlying physiology; use of these models to improve interpretation of prognosis. 	<ul style="list-style-type: none"> Development of mathematical models to extract numbers of viable transplantable cells as a function of time in SPECT. (LHRI) Development of mathematical models to extract hemodynamic parameters from contrast-enhanced X-ray CT studies. (LHRI) Development of mathematical models to quantitate PET tracer uptake using attenuation coefficients from X-ray CT. (LHRI)
Intellectual property development	<ul style="list-style-type: none"> Pursue patenting with timely disclosure of patentable ideas. 	<ul style="list-style-type: none"> 4 patents received. 9 disclosures filed.
Technology transfer/Industry linkage	<ul style="list-style-type: none"> Expanded application of techniques developed within consortium to company products. 	<ul style="list-style-type: none"> Ambulatory blood pressure monitoring system (CANAMET Inc.) Novel contrast agent in MR (MultiMagnetics)
Program Development - Growth and Sustainability	<ul style="list-style-type: none"> Expansion of peer-reviewed grant funding held by participants. 	<ul style="list-style-type: none"> CIHR (Macgowan, Yoo), HSF (Macgowan) awarded to HSC. New NIH/CIHR grant (Weissleder/Rutt, Co-PIs) funded in 2004 CIHR (Prato, Wells, Wisenberg) and HSF (Wells, Lee deKemp) awarded to LHRI. CIHR Proof of Principle (Wright, Dick), HSF (Dick, Wright) and NSERC (Rowlands) awarded to SWRI. CIHR and HSF (Beanlands), NIH and NSERC (deKemp) awarded to UOHI.
	<ul style="list-style-type: none"> Development of new contracts between industry and institutions. 	<ul style="list-style-type: none"> Several new collaborations with industry are presently awaiting approval from ORDCE. Evaluation of EXCITE III hardware and software for GE (led by Dr. Babyn at HSC). Contracts with CANAMET and MultiMagnetics Inc. at LHRI. SWRI and GE signed agreement on joint development of imaging for cardiac intervention.

Milestones	Goals	Outcome
	<ul style="list-style-type: none"> Expansion of related activities, notably sponsored clinical trials at participating institutions. 	<ul style="list-style-type: none"> Ongoing work on PARR 2. NIH Trial of Fontan circulation by MR (HSC). RCT Outline resubmitted for CIHR Randomized Controlled Trials Program in January 2005 (LHRI & UOHI).
	<ul style="list-style-type: none"> Growth of Ontario-based activity in companies in this field. 	<ul style="list-style-type: none"> Ongoing (See New Contracts above). GE Healthcare advertising for 3 research positions in Ontario.
	<ul style="list-style-type: none"> Funding applications in association with ongoing support of ORDCF-paid personnel. 	<p>Applications were submitted in 2004 to secure funding for further development of the cardiac imaging programs at the institutions listed below:</p> <ul style="list-style-type: none"> New CIHR application under development by Yoo, Macgowan, et al at HSC. Drs. Prato and Wisenberg submitted to CIHR and HSF at LHRI. Drs. Drangova, Boughner & Peters submitted at RRI. Drs. Dick and Wright submitted to CIHR and HSF at SWRI. Drs. Beanlands, Chow and DaSilva submitted to CIHR and HSF at UOHI. Drs. Prato, Dick and Wright submitted a LOI for a CIHR New Emerging Teams Grant.

5. Schedule C: Deliverables, Performance Measures and Outcomes

Deliverables	Performance Measures	Outcome
Governance	<ul style="list-style-type: none"> Completed Board meetings; distribution of minutes to membership 	<ul style="list-style-type: none"> 3 Board meetings held in 2004.
Communication/Collaborations	<ul style="list-style-type: none"> Scientific symposium plus 3 workshops per year. 	<ul style="list-style-type: none"> 2004 Annual INO Symposium held in Toronto March 3–5, 2004. Supported 2 scientific sessions (coronary and interventional MRA), held in conjunction with the MR Angiography Workshop 2004, in London, ON (October 6, 2004).
	<ul style="list-style-type: none"> Invited talks by participants. 	<ul style="list-style-type: none"> 63 invited lectures by participants. (Refer to Appendix I, Invited Lectures.)

Deliverables	Performance Measures	Outcome
	<ul style="list-style-type: none"> Joint projects, papers, and presentations involving multiple researchers in consortium. 	<ul style="list-style-type: none"> 2 multi-institutional research positions supported for collaborative projects within member institutions of the consortium. 4 joint patents received. 1 joint disclosure made. 16 joint papers published. 47 joint abstracts published.
	<ul style="list-style-type: none"> Web site hits. 	<ul style="list-style-type: none"> 28,901 hits.
Administration	<ul style="list-style-type: none"> Approved audit. 	<ul style="list-style-type: none"> Completed
	<ul style="list-style-type: none"> Timely financial reporting. 	<ul style="list-style-type: none"> Financial report filed as scheduled.
	<ul style="list-style-type: none"> Completed Annual report of performance measures. 	<ul style="list-style-type: none"> Annual Report submitted. Ongoing monitoring of research activities and milestones.
Recruitment and development of scientific personnel	<ul style="list-style-type: none"> Total scientific personnel involved in OCCI. 	<ul style="list-style-type: none"> 65.5 total new hires in 2004.
	<ul style="list-style-type: none"> Advancement/promotion of participants. 	<ul style="list-style-type: none"> Please see previous section on pages 13-14 for details on new Principal Investigators.
	<ul style="list-style-type: none"> Total trainees, grant funding, annual publications, presentations, awards. 	<ul style="list-style-type: none"> 25 trainees – Grad students, postdocs and clinical fellows; \$3.3M (Cdn) & \$5.5M (US) in new funding; 53 peer-reviewed papers; 1 book chapter; 172 presentations and invited lectures; and 5 awards.
Training	<ul style="list-style-type: none"> Track new students, postdoctoral fellows, clinical research fellows, and technical staff joining labs of OCCI scientific personnel. 	<ul style="list-style-type: none"> 36 new students were enrolled. 10 postdoctoral/clinical research fellows were mentored. 18.5 technical and engineering personnel were hired.
	<ul style="list-style-type: none"> Track scientific presentations, publications by trainees. 	<ul style="list-style-type: none"> 50 peer-reviewed papers; 1 book chapter; 90 presentations and abstracts.
	<ul style="list-style-type: none"> Track degrees earned. 	<ul style="list-style-type: none"> 5 MSc and 4 PhD graduates completed their training in 2004.
	<ul style="list-style-type: none"> Compile list of trainees and their employment status after training (target >50% of trainees working in Ontario 5 years after completion of studies). 	<ul style="list-style-type: none"> Tracked career paths of 7 graduates – 3 are postdoctoral fellows; 1 is a medical physicist resident, 1 is a medical school resident; 1 is a graduate student and 1 has joined an OCCI spin-off company.
Laboratory development	<ul style="list-style-type: none"> Inventory of research equipment and upgrades. 	<ul style="list-style-type: none"> Ongoing as planned.
Scientific advances in research projects	<ul style="list-style-type: none"> Portfolio of demonstrative images on Web site. 	<ul style="list-style-type: none"> Ongoing Web site updates of research activities. Total hits: 28,901 tracked within the period of 365 days.

Deliverables	Performance Measures	Outcome
	<ul style="list-style-type: none"> • Publications. 	<ul style="list-style-type: none"> • Published 53 scientific manuscripts in major peer-reviewed scientific journals.
	<ul style="list-style-type: none"> • Presentations at scientific conferences. 	<ul style="list-style-type: none"> • 173 presentations and lectures made at national and international scientific conferences; public forums; and workshops and symposia.
Intellectual property development	<ul style="list-style-type: none"> • Portfolio of patents, copyrighted software. 	<ul style="list-style-type: none"> • 4 patents. • 1 copyright.
	<ul style="list-style-type: none"> • Patent disclosures. 	<ul style="list-style-type: none"> • 9 disclosures filed.
Technology transfer/Industry linkage	<ul style="list-style-type: none"> • Actual cash and in-kind contributions received from industry. 	<ul style="list-style-type: none"> • \$1,697,026 in cash and in-kind contributions received from industry in 2004.
	<ul style="list-style-type: none"> • Licensing of IP to industry partners. 	<ul style="list-style-type: none"> • Negotiations are proceeding between LRI and GE Healthcare for licensing of CT Perfusion software.
Program development - Growth and sustainability	<ul style="list-style-type: none"> • New agreements between industry and institutions. 	<ul style="list-style-type: none"> • 2 research agreements signed with industry partners.
	<ul style="list-style-type: none"> • New grant funding to participants. 	<ul style="list-style-type: none"> • Awarded 12 new grants from CIHR, HSF, NIH and NSERC.
	<ul style="list-style-type: none"> • Expanded institutional revenues from related activity (clinical trials, licensing, etc.) 	<ul style="list-style-type: none"> • \$257,350 awarded in 2004 for clinical trials. Please see Appendix I for details.
	<ul style="list-style-type: none"> • Spin-off companies, licensing arrangements, Ontario-based employees in related companies. 	<ul style="list-style-type: none"> • Ongoing negotiations for licensing with GE Healthcare. • GE Healthcare advertising for 3 researchers in Ontario.

Appendix I:
Award, Patent, Publication and Presentation Lists

Awards and Distinctions

Brzozowski L. Governor General's Gold Medal for Scholastic Achievement, 2004.

Gold G, Hargreaves BA, Han E, Pauly J, **Wright GA**, Herfkens R, Brittain J, Beaulieu C. Cum Laude Award, Society of Computed Body Tomography and Magnetic Resonance, Outstanding Paper, 2004.

Hunt D and **Rowlands JA**. Young Investigators Prize, Young Investigators' and Image-Guided Therapy Symposium, American Association of Physicists in Medicine (AAPM) - The Great Lakes Chapter, November, 2004.

Lee, T-Y. Award for Excellence in Research, Diagnostic Radiology & Nuclear Medicine, The University of Western Ontario, July 2004.

Nii M, Roman KS, **Macgowan CK**, **Smallhorn JF**. Richard Rowe Research Award, Canadian Cardiovascular Congress, 2004.

Research Agreements and Grants

1. Canadian Institutes of Health Research, Operating Grant, 2004-2007
Title: Importance of mechanical dyssynchrony and resynchronization therapy in advanced heart failure patients.
Birnie DH, Ruddy TD, Tang AS, Wells GA
CDN \$199,986
2. Canadian Institutes of Health Research, Operating Grant, 2004-2009
Title: Imaging in Ischemic Heart Disease: Making Diagnosis, Following Therapy
Prato FS, Drost DJ, Merrifield P, **Wells RG**, **Wisenberg G**. (Collaborators: McKenzie CA, Moran G, **Wright GA**, **Kovacs M**, Gambhir SS)
CDN \$777,581
3. Canadian Institutes of Health Research, Operating Grant, 2004-2007
Title: MRI Assessment of Pulmonary Hemodynamics within the Lungs
Macgowan CK, Yoo S-J
CDN \$212,279
4. Canadian Institutes of Health Research, Proof of Principle, 03/2004-02/2005
Title: A 6-Degree-of-Freedom Device for 3D Navigation in Real-time Magnetic Resonance Imaging
Wright GA, Dick AJ
CDN \$98,722
5. Heart & Stroke Foundation of Canada, Grants-in-Aid, 2004-2006
Title: Left Ventricular Mass Regression Following Aortic Valve Replacement with Stentless Versus Stented Valves: Follow-up of a Randomized Trial Delivery and Tracking of Stem Cells in Acute Myocardial Infarction

- Cohen G, Alter D, Ivanov J, **Macgowan C, Burns P** (collaborators: **Wright GA, Dick A**, Joyner C)
 CDN \$89,350
6. Heart & Stroke Foundation of Canada, Grant-in-Aid, 07/2004-06/2006
 Title: Delivery and Tracking of Stem Cells in Acute Myocardial Infarction
Dick AJ, Wright GA, Stewart DJ
 CDN \$130,076
 7. Heart and Stroke Foundation of Canada, Grant-in-Aid, 2004-2006
 Title: Pathophysiologic Characterization and Therapeutic Intervention in the PRKAG2 Cardiac Syndrome
 Gollob M, **Beanlands R**
 CDN \$150,000
 8. Lawson Health Research Institute, Internal Research Fund, 2004-2006
 Diagnosis of Cerebral Small Vessel Disease Based on Thalamic Perfusion Measurements Using Dynamic Contrast-Enhanced Computer Tomography
 Chan RK, **Lee T-Y**
 CDN \$15,000
 9. National Institutes of Health, 2004-2009
 Title: Hibernating myocardium and sudden cardiac death
 Canty J, Fallavollita J, **deKemp R**
 US \$3,563,287
 10. NIH/CIHR, 2004-2008
 Title: MR Imaging of Myeloperoxidase Activity
 Weissleder R, **Rutt B**
 US \$2.3 M
 11. Natural Sciences and Engineering Research Council, RTI 1, 2004-2005
 Title: Equipment for Electrical Impedance Tomography
 Adler A, Masters R, **deKemp R**, Mussivand T
 CDN \$50,000
 12. Natural Sciences and Engineering Research Council (Collaborative Health Research Project), 2004-2007
 Title: Novel approaches to flat panel detectors
 Nathan A, **Rowlands JA**, Kasap SO and Karim K
 CDN 486,000
 13. CV Therapeutics, 2004 – 2005
 Title: A Phase III, Randomized, Double-Blind Study of Intravenous CVT-3146 vs Adenoscan in Patients Undergoing Stress Myocardial Perfusion Imaging.
Ruddy T
 CDN \$168,000

Patents

1. **Macgowan CK, Sussman MS, Wright GA.** System and Method for Generating Spectra. US Patent 6,753,683, issued June 22, 2004.
2. Stainsby JA, Goldman T, **Sussman MS, Wright GA.** Realtime MR Scan Prescription using Physiological Information. US Patent 6,704,593, issued March 9, 2004.
3. Stodilka RZ, **Prato FS,** Kemp BJ and Nicholson RL. Application of scatter and attenuation correction to emission tomography images using inferred anatomy from atlas. US Patent 6,740,883, 2004.
4. **Sussman MS, Wright GA,** Cunningham C. Magnetic Resonance Imaging using Direct, Continuous Real-Time Imaging for Motion Compensation. US Patent 6,675,034, issued January 6, 2004.

Disclosures Filed

1. Anderson K, **Wright GA.** Catheter Tracking with Phase Information. (disclosure filed, April 2004).
2. Cunningham C, Derbyshire JA, Pauly J, Santos J, Stainsby JA, **Wright GA.** RF Pulses with Built-in Saturation Sidebands. (disclosure filed, September 2004).
3. **Joy ML,** Hasanov KF, Yoon RS, Nachman AI. Current Density Impedance Imaging, CDII, US (disclosure filed, November 2004).
4. **Joy ML,** Hasanov KF, Yoon RS, Nachman AI. Current Density Impedance Imaging, CDII, Canadian (2480430) (disclosure filed, November 2004).
5. **Prato FS,** McCreary C, Dhanvantari S, Hill D. A Novel Contrast Agent for MRI. (disclosure filed, 2004).
6. Roberts TPL, Flagg E, **Sussman MS.** Device for Reducing Motion-Related Artifacts in Parallel Magnetic Resonance Imaging, (disclosure filed, 2004)
7. **Sussman MS, Merchant N, Wright GA,** White LM. Method for Motion Correction in Magnetic Resonance Imaging Based on Selecting Data from the Similarity of Direct Navigator Echoes, (disclosure filed, 2004).
8. Yi D, **Wright GA,** Hu B. Device and Process for Manipulating Real and Virtual Objects in Three-Dimensional Space. (disclosure filed, February 2004).
9. Zhao W and **Rowlands JA.** An Indirect Flat-panel Detector with Avalanche Gain. (disclosure filed, 2004).

Copyrights

1. **deKemp RA.** Copyright MyoPC© - Image Analysis Software for Cardiac Positron Emission Tomography (PET). Canadian Intellectual Property Office, 2004.

Technology Transfers

1. **deKemp RA, Wells RG.** Rb generator SOPs. Technology transfer agreement between University of Ottawa Heart Institute and St. Joseph's Health Care London and Lawson Health Research Institute, London, ON, 2004.

Peer-Reviewed Publications

1. Aladl U, Hurwitz G A, Dey D, Levin D, **Drangova M**, Slomka PJ. Automated image registration of gated cardiac single-photon emission computed tomography and magnetic resonance imaging. *JMRI*, 19, 283-290, 2004.
2. Al-Kwafi O, Kim JK, Stainsby J, Huang Y, **Sussman MS**, Farb RI, **Wright GA.** Pulsatile Motion Effects on 3D Magnetic Resonance Angiography: Implications for Evaluating Carotid Artery Stenoses, *Magn Reson Med.* 2004 52(3):605-611.
3. Ananthasubramaniam K, Chow BJ, **Ruddy TD, deKemp R, Davies RA**, DaSilva J, **Beanlands RS.** Does electrocardiographic Q wave burden predict the extent of scarring or hibernating myocardium as quantified by positron emission tomography? *Can J Cardiol.* 2005 Jan;21(1):51-6.
4. Beck-da-Silva L, deBold A, **Davies R**, Chow B, **Ruddy T**, Fraser M, Struthers C, Haddad H: Effect of bisoprolol on right ventricular function and brain natriuretic peptide in patients with heart failure. *Congest Heart Fail* 2004;10:127-132.
5. Cook C, Thomas A, Keenlside L, **Prato FS.** Resting effects during exposure to a pulsed ELF magnetic field. *Bioelectromagnetics*, 25:196-203, 2004.
6. Costa AF, Petrie DW, Yen YF and **Drangova M.** Using the axis of rotation of polar navigator echoes to rapidly measure 3D rigid-body motion. *Magn Res Med.* 53(1), 150-158, 2004.
7. Costa AF, Petrie DW, Yen YF, **Drangova M.** Using the axis of rotation of polar navigator echoes to rapidly measure 3D rigid-body motion. *Magn Reson Med.* 2005 Jan;53(1):150-8.
8. Crean A, **Merchant N.** Role of cardiac magnetic resonance imaging in identification of amyloid cardiomyopathy. *Indian Heart J.* 2004 Nov-Dec;56(6):682-3.
9. **Davies RA**, Abdullah S, Cohen E, Knudtson M, Collins-Nakai R, Lacroix C, Taylor G, Tu JV, Wilson E; Canadian Cardiovascular Information Network Investigators. Issues influencing development of the Canadian Cardiovascular Information Network. *Can J Cardiol.* 2004 May 1;20(6):637-41.
10. Deoni CL, Ward HA, Peters TM and **Rutt BK.** Rapid T2 estimation with phase-cycled variable nutation steady-state free precession. *Magn Reson Med.*, 2004; 52:435-439.
11. Deoni SCL, Peters TM and **Rutt BK.** Determination of optimal angles for variable nutation proton magnetic spin-lattice, T1, and Spin-spin, T2, Relaxation times measurement. *Magn Reson Med.* 2004; 51:194-199.

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78. Stainsby JA, Hu N, Yi D, Radau P, Santos JM, **Wright GA**. Integrated Real-time MRI User-Interface. 12th Scientific Meeting of International Society for Magnetic Resonance in Medicine, May 15-21, 2004 Kyoto, Japan.
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80. **Sussman MS**, **Merchant N**, **Wright GA**, White LM. The Similarity-Based Navigator Echo (SIMNAV). 12th Scientific Meeting of International Society for Magnetic Resonance in Medicine, May 15-21, 2004 Kyoto, Japan, p.2152.
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95. Winter JD, Gelman N, Lee DSC, Levin S, **Thompson RT**. Quantitative Apparent Diffusion Coefficient Values and T2 Relaxation Rates in Term Neonates with Suspected Hypoxic Ischemic Injury. ISMRM, Twelfth Annual Meeting, May 2004, Kyoto.
96. Winter JD, Gelman N, Lee DS, Levin S, **Thompson RT**. Quantitative Apparent Diffusion Coefficient Values and R2 Relaxation Rates in Term Neonates with Suspected Hypoxic Ischemic Injury. Imaging Network Ontario Symposium, 2004, Toronto.
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98. Wong J, **Beanlands R**, **Ruddy TD**, **deKemp RA**, Yoshinaga K, Chow BJW. Prognostic Significance of Dipyridamole Induced ST-Segment Depression in Patients with Normal Rb-82 Positron Emission Tomography Perfusion Images. J Am Coll Cardiol 2004;43(Suppl A):338A-1094-160.
99. **Wright GA**, Stainsby JA, Hu N, Yi D, Radau P. Improved visualization and control for scan plane navigation in real-time cardiac MRI. J Cardiovasc Magn Reson, 2004.
100. Yang Y, Foltz W, Hong J, Stainsby JA, Dharmakumar R, **Merchant N**, **Wright GA**. MR Feasibility Study of Global Left Ventricular Myocardial Oxygen Consumption in Normal Volunteers: Preliminary Results. 12th Scientific Meeting of International Society for Magnetic Resonance in Medicine, May 15-21, 2004 Kyoto, Japan.
101. Yi D, Radau P, **Wright GA**. Visualization and Surgical Planning Using a Cost-effective, Six Degree-of-freedom (6-DOF) Navigator. infoRAD Demonstration and infoRAD Theatre Presentation, Radiological Society of North America, November 28-December 3, 2004.
102. Yi D, Stainsby JA, **Wright GA**. Intuitive and Efficient Control of Real-time MRI Scan Plane Using a Six-degree-of-freedom Hardware Plane Navigator. Lecture Notes on Computer Science, Proceedings of MICCAI 2004, September 26-30, 2004.
103. Yi D, **Wright GA**. Design of a Cost-effective 6DOF Mechanical Armature for Real-Time MRI Scan Plane Prescription. 12th Scientific Meeting of International Society for Magnetic Resonance in Medicine, May 15-21, 2004 Kyoto, Japan.
104. Yoshinaga K, **Beanlands R**, **deKemp R**, Lortie M, Morin J, Aung M. Effect of Exercise Training on Myocardial Blood Flow in Patients with Stable Coronary Artery Disease. Circulation 2004; Vol 110 No 17(Suppl III):III-150-2606.

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106. Yoshinaga K, Chow B, **deKemp R**, Williams K, Garrard L, Aung M, Mostert K, Gauthier D, **Davies RA, Ruddy T, Beanlands R**. Prognostic value of rubidium-82 perfusion positron emission tomography: Preliminary results from the consecutive 153 patients. *J Am Coll Cardiol* 2004;Vol 43 No 5 (Suppl A):338A-1094-159.
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109. Zhao W and **Rowlands JA**. Avalanche multiplication flat panel imagers. *Medical Imaging 2004: Physics of Medical Imaging, Proc. SPIE 5368* 150-161 (2004).
110. Zhao W, Tanioka K, Hunt DC, **Rowlands JA**. A new flat-panel detector for low dose digital x-ray imaging. *IEEE meeting Medical Imaging Conference (October 2004)*.

Invited Lectures

1. **Beanlands RS**. Cardiac PET, 4th Cardiac Imaging Symposium - Ottawa, Ontario (October 15, 2004)
2. **Beanlands RS**. Myocardial blood flow and coronary microvascular function in patients with risk factors for CAD. PET & Fusion Imaging Advisory Board Meeting - Amersham Health - London, UK (February 19, 2004)
3. **Beanlands RS**. Myocardial Viability. Post-Graduate Cardiology Rounds (May 25, 2004)
4. **Beanlands RS**. Update – Cardiac Perfusion PET study. Ontario PET Steering Committee - A Retreat on Positron Emission Tomography - Toronto, Ontario (December 1, 2004)
5. **Beanlands RS**. Metabolic Imaging. Society of Nuclear Medicine Faculty - Lecture prepared by R Beanlands RS, presented by M DiCarli - Arizona, NM (January 24, 2004)
6. **Beanlands RS**. Walking Your PET - Research Update. University of Ottawa Heart Institute Annual Cardiology Retreat (January 24, 2004)
7. **deKemp RA**. Attenuation Correction in PET and SPECT. Nuclear Medicine Technologists Symposium, Ottawa, ON, April 2004
8. **deKemp RA**. Micro-PET Molecular Imaging in Cancer and Cardiovascular Research. Ottawa Medical Physics Institute, The Ottawa Hospital Regional Cancer Centre, Ottawa, ON, October 2004.

9. **deKemp RA.** OCOG PET Imaging Standards. Ontario Clinical Oncology Group – ELPET and PETSTART launch, The Ottawa Hospital Regional Cancer Centre, Ottawa, ON, Feb 2005.
10. **deKemp RA.** Serial PET Imaging and CAD – computer assisted diagnosis? University of Ottawa Heart Institute, ON, Jan 2004
11. **deKemp RA.** Performance Testing of the ECAT ART+ (P39 Vision 3000) at St. Joseph’s Healthcare, Hamilton, ON, 2004.
12. **deKemp RA.** PET Imaging Standards for OCOG Clinical Trials. Adopted by Clinical Trials Methodology Group, Ontario Clinical Oncology Group, Hamilton, ON, 2004.
13. **Dick AJ,** Interventional MRI, Cardiovascular Science Day, University of Toronto, May, 2004.
14. **Dick AJ,** Interventional MRI: From Animals to Humans, MR Angio Club, London, ON, October 2004.
15. **Lee TY,** CT Perfusion Principles and Applications. Developments in X-Ray Tomography IV: Optical Science and Technology Conference, The International Society for Optical Engineering 49th Annual Meeting, Denver, CO, USA: August 2-6, 2004.
16. **Lee TY,** New Developments in CT Functional Studies of the Heart. Cardiovascular Grand Rounds, London Health Sciences Centre, London, ON: November 15, 2004.
17. **Macgowan CK.** How to Minimize Magnetic-Resonance Artifacts. Pediatric Cardiovascular MR Symposium, Society for Pediatric Radiology, Houston, TX. April 5, 2004.
18. **Macgowan CK.** How to Reduce Magnetic-Resonance Artifacts Downtown Imaging Research Lecture Series, Toronto, Canada – February 2, 2004.
19. **Macgowan CK.** Magnetic Resonance Artifacts. 19th Annual Organ Imaging Review, University of Toronto, Toronto, ON. September 29, 2004
20. **Macgowan CK.** Optimization of 3D Contrast-Enhanced Pulmonary MRA in Paediatric Patients with Cardiovascular Disease. 16th Annual International MR Angiography Workshop, London, ON. October 7, 2004.
21. **Prato FS** (with Dr. S. Dhanvantari) A Multi Modality Approach to Stem Cell Tracking and Function in an Autologous Canine Model of Myocardial Infarction. The Society of Molecular Imaging, Third Annual Meeting, St. Louis, MO, September 9-12, 2004.
22. **Prato FS.** Are there non-thermal deterministic (non-stochastic) effects from exposure to MRI procedures. ICNIRP/WHO/URSI International NIR Workshop and Symposium, Seville, Spain, May 20-22, 2004.
23. **Prato FS.** Biological Effects of Extremely Low Frequency Magnetic Fields: From Molecules to Humans. Two decades of research at the University of Western Ontario. McMaster University, Hamilton, ON, June 15, 2004.
24. **Prato FS.** Myocardial Stem Cell Therapy: Role of MRI. 16th Annual Magnetic Resonance Angiography Workshop, London Convention Centre, London, ON, October 6-8, 2004.
25. **Smallhorn JF.** 3D echocardiography-does it and will it have an impact of cardiac investigations in children? Paediatric Cardiology Division IWK, Children’s Heart Center,

- Halifax, Nova Scotia, Apr 12-14, 2004.
26. **Smallhorn JF.** The non-invasive assessment of mitral valve regurgitation-attempting to link morphology, volume and function. Paediatric Cardiology Division, IWK Children's Heart Center, Halifax, Nova Scotia, Apr 12-14, 2004.
 27. **Smallhorn JF.** Tissue Doppler assessment of systolic function in congenital heart disease: Is there a load independent index? 16th Congress of the Brazilian Echocardiography Society, Belo Horizonte Brazil, Apr 29 - May 1, 2004.
 28. **Smallhorn JF.** 3D echo in congenital heart disease: Why do we need it. 16th Congress of the Brazilian Echocardiography Society, Belo Horizonte Brazil, Apr 29 - May 1, 2004.
 29. **Smallhorn JF.** Does contrast echocardiography have a role to play in the pediatric population? 16th Congress of the Brazilian Echocardiography Society, Belo Horizonte Brazil, Apr 29 - May 1, 2004.
 30. **Smallhorn JF.** Atrioventricular valve assessment by three-dimensional echocardiography in congenital heart disease: Pretty pictures of useful information. 16th Congress of the Brazilian Echocardiography Society, Belo Horizonte Brazil, Apr 29 - May 1, 2004.
 31. **Smallhorn JF.** Tetralogy of Fallot as assessed by echocardiography. Mayo Clinic. 20th Annual Echocardiography in Paediatric and Adult Congenital Heart Disease, Rochester, Minnesota, Oct 3 - Oct 6, 2004.
 32. **Smallhorn JF.** Anomalous origin of the pulmonary arteries by echocardiography. Mayo Clinic. 20th Annual Echocardiography in Paediatric and Adult Congenital Heart Disease, Rochester, Minnesota, Oct 3 - Oct 6, 2004.
 33. **Smallhorn JF.** Kawasaki syndrome: How can I tell when the coronary arteries are normal. Mayo Clinic. 20th Annual Echocardiography in Paediatric and Adult Congenital Heart Disease, Rochester, Minnesota, Oct 3 - Oct 6, 2004.
 34. **Smallhorn JF.** Three-dimensional echocardiography: A mature clinical tool or still an evolving modality. Mayo Clinic. 20th Annual Echocardiography in Paediatric and Adult Congenital Heart Disease, Rochester, Minnesota, Oct 3 - Oct 6, 2004.
 35. **Stodilka RZ.** Evaluation of Hybrid PET using Estimation Task Performance. Nuclear Medicine Grand Rounds, Faculty of Medicine, University of Western Ontario, 2004.
 36. **Sussman MS.** A New Method for MR Imaging of Moving Anatomy. Department of Medical Imaging Research Day, Toronto, Ontario, April 29, 2004.
 37. **Sussman MS.** Magnetic Resonance Imaging (MRI) Safety. Hospital for Sick Children, Toronto, Ontario, August 12, 2004.
 38. **Sussman MS.** The Similarity-Based Navigator Echo (SIMNAV). 17th Annual MRI Retreat, Toronto, Ontario, September 23, 2004.
 39. **Wright GA, Dharmakumar R, Hong J, Brittain JH.** "Vascular Oxygen-Sensitive Contrast Using SSFP Methods", 16th Annual International Workshop on Magnetic Resonance Angiography, October 6-9, 2004.
 40. **Yoo S-J.** Basic MR Cardiac Functional Evaluation. Society for Pediatric Radiology, Refresher Course, Savannah, April 27-May 1, 2004.

41. **Yoo S-J.** Cardiac CT. 2nd SPR Symposium on Pediatric Cardiovascular MR, Houston, April 1-5, 2004.
42. **Yoo S-J.** Case-Based Review, Pediatric, Cardiovascular. Radiological Society of North America, Chicago, November 27-December 3, 2004.
43. **Yoo S-J.** Fetal Cardiac Screening. Cincinnati Children's Hospital, October 1, 2004.
44. **Yoo S-J.** Future Trends of Pediatric Cardiac Imaging. Samsung Cheil Hospital, Korea, November 16, 2004.
45. **Yoo S-J.** Future Trends, Cardiac Imaging. 23rd Congress of Radiology, Montreal, June 25-29, 2004
46. **Yoo S-J.** Imaging in Heterotaxy Syndromes. Adult Congenital Heart Disease Round, Toronto General Hospital, January 21, 2004.
47. **Yoo S-J.** MR Assessment of Cardiac Function in Children. Asan Medical Center, Seoul, Korea, November 15, 2004.
48. **Yoo S-J.** MR Evaluation of Pulmonary Circulation Disorders, Woonpa Memorial Lecture. Seoul National University Hospital, Seoul, Korea, November 12, 2004.
49. **Yoo S-J.** MR Evaluation of Pulmonary Circulation Disorders. Yonsei University Hospital, Seoul, Korea, November 16, 2004.
50. **Yoo S-J.** MR Evaluation of Pulmonary Circulation. Cincinnati Children's Hospital, September 30, 2004.
51. **Yoo S-J.** Normal Cardiac Anatomy for Imaging. 2nd SPR Symposium On Pediatric Cardiovascular MR, Houston, April 1-5, 2004.
52. **Yoo S-J.** Normal Cardiac Anatomy for Imaging. Resident and Fellow Round, Women's and Children's Hospital, Buffalo, January 9, 2004.
53. **Yoo S-J.** Normal Cardiac Anatomy for Imaging. Seoul National University Hospital, Seoul, Korea, November 17, 2004.
54. **Yoo S-J.** Pediatric Cardiac MR. Women's and Children's Hospital, Buffalo, January 9, 2004.
55. **Yoo S-J.** Pediatric Cardiovascular MR, Overview. Cincinnati Children's Hospital, September 30, 2004.
56. **Yoo S-J.** Plain film interpretation of of congenital heart disease. Resident and Fellow Round, Women's and Children's Hospital, Buffalo, January 9, 2004.
57. **Yoo S-J.** Postoperative MR Evaluation of Congenital Heart Disease. Cincinnati Children's Hospital, October 1, 2004.
58. **Yoo S-J.** Postoperative MR Evaluation. 2nd SPR Symposium on Pediatric Cardiovascular MR, Houston, April 1-5, 2004.
59. **Yoo S-J.** Practicum. 2nd SPR Symposium on Pediatric Cardiovascular MR, Houston, April 1-5, 2004.
60. **Yoo S-J.** Research Cardiac MR Projects at the Hospital for Sick Children in Toronto. Samsung Medical Center, Seoul, Korea, November 17, 2004.

61. **Yoo S-J.** Sequential Segmental Approach to Congenital Heart Disease. 2nd SPR Symposium on Pediatric Cardiovascular MR, Houston, April 1-5, 2004.
62. **Yoo S-J.** Sequential Segmental Approach to Congenital Heart Disease. 19TH Annual Organ Imaging Review, September 29, 2004.
63. **Yoo S-J.** What's New in Pediatric Cardiology, Sejong Heart Institute, Pucheon, Korea, November 11, 2004.

Appendix II:

Workshop Programs

**Imaging Network Ontario 2004 Symposium
MRA Club 2004 Workshop**

Imaging Network Ontario 2004 Symposium

Wednesday, March 3, 2004

Behavioural Research and Imaging Network

8:00 AM Welcome

Brain Imaging using Synthetic Aperture Magnetometry

8:05 AM Introduction to Beamformers
Jiri Vrba, PhD, CTF System Inc, Subsidiary of VSM Medtech, Ltd., Vancouver

Application of SAM Virtual Sensors for MEG Data in Epilepsy Patients

8:35 AM Makoto Oishi, MD, Department of Neurology, The Hospital for Sick Children,
Toronto

8:55 AM Localizing Auditory Evoked Responses using SAM
Anthony A. Herdman, PhD, Rotman Research Institute, Baycrest Centre for Geriatric
Care, Toronto

9:25 AM Using SAM to Image Cortical Oscillations
William Gaetz, PhD, Neuromagnetic Imaging Laboratory, The Hospital for Sick
Children, Toronto

9:55 AM COFFEEBREAK

Optical Imaging of the Brain

10:30 AM Functional Optical Imaging of the Visual Cortex
Kathryn M. Murphy, PhD, Professor, Visual Neuroscience Laboratory, McMaster
University, Hamilton

11:00 AM Laser Speckle-Contrast Imaging of Blood Vessels and Blood Flow in the Developing
Cortex
David Jones, PhD, Electrical and Computer Engineering, McMaster University,
Hamilton

11:30 AM The Fine Structure of Cerebral Vasculature and its Relationship to Specialized
Sensory Areas in Cortex
Robert Harrison, PhD, Auditory Science Laboratory, Hospital for Sick Children,
Toronto

Noon LUNCH

Image Assessment of Risk for Acute Coronary Syndrome
Ontario Consortium for Cardiac Imaging

- 1:00 PM Welcome
Graham A. Wright, PhD, Research Director, Heart and Circulation Program
Sunnybrook and Women's College Health Sciences Centre, Toronto
- 1:05 PM Biology of Atherosclerosis: Balancing Inflammation and Repair
Edward R. O'Brien, MD, Director, Vascular Biology Laboratory
University of Ottawa Heart Institute, Ottawa

Imaging Characteristics of the Wall

- 1:35 PM 3D Ultrasound Imaging of Plaques in the Carotid Arteries
Aaron Fenster, PhD, Director, Imaging Research Laboratories
Robarts Research Institute, London
- 1:50 PM New Directions in Atherosclerotic Plaque Risk Assessment by MRI
Brian Rutt, PhD, Scientist, Imaging Research Laboratories
Robarts Research Institute, London
- 2:05 PM Optical Techniques for In Situ Characterization of Atherosclerotic Plaque
Brian C. Wilson, PhD, Head, Division of Physics
Ontario Cancer Institute, Toronto
- 2:20 PM Imaging Vascular Information with PET and FDG
Terrence D. Ruddy, MD, Director, Nuclear Cardiology
University of Ottawa Heart Institute, Ottawa
- 2:35 PM Discussion, led by
Alan Moody, MD, Radiologist-in-Chief, Medical Imaging,
Sunnybrook and Women's College Health Sciences Centre, Toronto
- 2:50 PM COFFEEBREAK

Coronary Plaque Characterization

- 3:20 PM Coronary Plaque Characterization using Multi-detectors CT: Technique, Benefits and Limitations
Yves Provost, MD, University Health Network, Toronto
- 3:40 PM Tissue Characterisation with IVUS
Stephen Fort, MD
Director, Cardiac Catheterization Laboratory,
Queen Elizabeth II Health Sciences Centre, Halifax

- 4:00 PM Atherosclerotic Plaque Assessment with MRI: A potential for Molecular Imaging
Zahi A. Fayad, PhD
Director, Imaging Science Laboratories, Mount Sinai School of Medicine, New York
- 4:45 PM Discussion, led by
Graham A. Wright, PhD, Research Director, Heart and Circulation Program
Sunnybrook and Women's College Health Sciences Centre, Toronto
- 5:00 PM Adjournment

Thursday, March 4, 2004

Ontario Consortium for Small Animal Imaging

- 8:00 AM Welcome
F. Stuart Foster, PhD, Associate Chair
Department of Medical Biophysics, University of Toronto, Toronto
- 8:05 AM Biomedical Imaging in Drug Discovery
Nicholas van Bruggen, PhD
Senior Scientist, Physiology/Biomedical Imaging, Genentech, Inc., San Francisco
- 8:50 AM Multiple Mouse MRI in Fixed and Live Mice
Jonathan Bishop, PhD
Mouse Imaging Centre, Hospital for Sick Children, Toronto
- 9:05 AM Comprehensive Transthoracic Cardiac Imaging in Wild-Type and Genetically Altered Mice using 30 MHz Ultrasound with Anatomical Confirmation by Magnetic Resonance Imaging
Yu-Qing Zhou, PhD, Mouse Imaging Centre, Hospital for Sick Children
- 9:20 AM A 3D Micro-Ultrasound Image Guided and Robotically Assisted Needle Positioning System
Adam C. Waspe, Biomedical Engineering, University of Western Ontario, London
- 9:35 AM Applications for Micro Computed Tomography in Small Animal Research
David W. Holdsworth, PhD, Scientist, Imaging Research Laboratories, Robarts Research Institute, London
- 10:05 AM COFFEEBREAK
- 10:30 AM Micro- and Cellular Imaging of Inflammation in Experimental Spinal Cord Injury
Paula Foster, PhD, Imaging Research Laboratories, Robarts Research Institute, London

- 10:45 AM Automated Image Analysis of Mouse Brain MR Images
Natasia Kovacevic, PhD, Mouse Imaging Centre, Hospital for Sick Children, Toronto
- 11:00 AM Quantitation of Developmental Vascular Regression in Normal and Transgenic Mouse Eye
Allison S. Duckett, PhD, Imaging Research, Sunnybrook and Women's College Health Sciences Centre, Toronto
- 11:15 AM Structural and Doppler Imaging of *Xenopus Laevis* Embryos In Vivo: A Comparison of Ultrasound Biomicroscopy and Optical Coherence Tomography
Andrew Needles, Imaging Research, Sunnybrook and Women's College Health Sciences Centre, Toronto
- 11:30 AM A Highly Flexible Automated Solid-Phase Synthesis Strategy for the Construction of Libraries of Re(I)/Tc(I) Radiopharmaceuticals
K.A. Stephenson, Department of Chemistry and Medical Physics, McMaster University, Hamilton
- 11:45 AM 3-D Visualization of Mouse Embryos with Optical Projection Tomography
Jonathan R. Walls, MSc, Department of Medical Biophysics, University of Toronto
- Noon LUNCH

Centre for Vascular Imaging Research

- 1:00 PM Overview and Final Report on CVIR
Brian Rutt, PhD
Project Leader, Centre for Vascular Imaging Research, London

Workshop on Intellectual Property and Commercialization

- 1:30 PM Opening Remarks
Susan Murley, PhD, Director, Special Projects – Research, Sunnybrook and Women's College Health Sciences Centre, Toronto
- 1:35 PM Fundamentals of Disclosing Research Data
Vigen Nazarian, Business Development Officer – Life Sciences Technology Transfer, University of Toronto
- 2:05 PM Regulatory Issues in Medical Device Marketing
John Kucharczyk, PhD
President & CEO, NexGen Medical Systems, Inc.
- 2:35 PM Financing Your Venture

Jeff Courtney
General Partner, VenGrowth Capital Ventures Inc.

3:05 PM Discussion, facilitated by
Susan Murley, PhD, Director, Special Projects – Research, Sunnybrook and Women’s
College Health Sciences Centre, Toronto

3:30 PM COFFEEBREAK

INO Keynote Address

4:00 PM Introduction
Michael Julius, PhD, Vice President, Research, Sunnybrook and Women’s College
Health Sciences Centre, Toronto

4:05 PM Keynote Address
30 Years of Digital Imaging in Medicine
Terry M. Peters, PhD, Director, Image Guided Surgery Laboratory, Robarts Research
Institute, London

4:45 PM Poster Competition Awards Presentation
Terry M. Peters, PhD, Director, Image Guided Surgery Laboratory, Robarts Research
Institute, London

5:00 PM RECEPTION

Friday, March 5, 2004

Joint Program -- Ontario Centre of Excellence in Breast Cancer Imaging Research and
Ontario Consortium for Image-Guided Therapy and Surgery

8:00 AM Welcome
Michael D. Sherar, PhD, Vice President, Integrated Cancer Program
London Health Sciences Centre, London

8:15 AM Mammography and Ultrasound Integration
Paul L. Carson, PhD
Director of Radiology's Division of Basic Radiological Sciences, University of
Michigan, Ann Arbor

9:00 AM Photodynamic Therapy for Spinal Metastases of Breast Cancer
Brian C. Wilson, PhD, Head, Department of Medical Biophysics
Ontario Cancer Institute, Toronto

9:20 AM Breast MRI/US Coregistration for Diagnosis and Intervention
Donald B. Plewes, PhD, Senior Scientist, Imaging Research
Sunnybrook and Women’s College Health Sciences Centre, Toronto

- 9:40 AM Development of a 3D Digital System for Breast Histopathology Imaging
Gina Clarke, MSc, Department of Medical Biophysics, University of Toronto, Toronto
- 10:00 AM COFFEEBREAK
- 10:30 AM Update on MR Controlled Focused Ultrasound Surgery
S. Morry Blumenfeld, PhD, Managing Director, MediTech Advisors, LLC, Israel
- 11:15 AM A Mobile C-Arm Platform for Volume CT-Guided Surgical Procedures
Jeffrey H. Siewerdsen, MD, Princess Margaret Hospital, University Health Network, Toronto
- 11:35 AM On-Line Imaging in Precision Radiotherapy
Jerry Battista, PhD, Director of Physics Research and Education
London Regional Cancer Centre, London
- 11:55 AM 3D Ultrasound & Stereo X-Ray Mammography Guided Breast Biopsy
Aaron Fenster, PhD, Director, Robarts Research Institute, London
- 12:15 PM LUNCH
- 1:15 PM Imaging the Breast with Alternatives to Conventional Practice
Keith D. Paulsen, PhD
Professor of Engineering, Thayer School of Engineering, Dartmouth College, Hanover, New Hampshire
- 2:00 PM An Integrated System for Cone-Beam CT Image-Guidance of High-Precision Radiotherapy
Douglas J. Moseley, PhD, Scientific Associate, Princess Margaret Hospital, University Health Network, Toronto
- 2:15 PM Dynamic Heart Model Validation: Towards Virtual Reality Training, Planning, and Guidance of Minimally Invasive Cardiac Surgery
Marcin Wierzbicki, Robarts Research Institute, London
- 2:30 PM Development of Image-Guided Transurethral Thermal Therapy for Prostate Cancer
Rajiv Chopra, PhD, Research Associate, Imaging Research
Sunnybrook and Women's College Health Sciences Centre, Toronto
- 2:45 PM Developing High Frequency Ultrasound and Signal Analysis Techniques to Monitor Organ Suitability for Transplantation
Roxana Vlad, Department of Medical Biophysics, University of Toronto, Toronto
- 3:00 PM COFFEEBREAK

- 3:15 PM Optimizing Tomosynthesis for Breast Imaging
James Mainprize, PhD, Research Associate, Imaging Research
Sunnybrook and Women's College Health Sciences Centre, Toronto
- 3:35 PM MR Imaging With Hyperpolarized Xenon: Development of a Novel Contrast Agent
Julia Wallace, PhD, Research Associate, Carleton Magnetic Resonance Facility
Carleton University, Ottawa
- 3:55 PM Doppler Optical Coherence Tomography for Monitoring Vascular Changes During
Photodynamic Therapy
Maggie L. Gordon, Departments of Medical Biophysics, and Radiation Oncology,
University of Toronto, Toronto
- 4:10 PM A New Artifact in CT:Secondary Effects of Spectral Beam Hardening in the X-ray
Detector
George Hajdok, PhD, Imaging Research Labs, Robarts Research Institute, London
- 4:25 PM Validation and Comparison Non-rigid 3D Image-registration Algorithms
Ting (Jessie) Guo, MEdSc, Imaging Research Laboratories, Robarts Research Institute
- 4:40 PM Robotically Aided Prostate Brachytherapy with 3D TRUS Guidance
Zhouping Wei, PhD, Imaging Research Laboratories, Robarts Research Institute
- 4:55 PM Closing Remarks

16th International Workshop on Magnetic Resonance Angiography

October 6, 2004

Scientific Program

3. Interventional MRA – Chairs: Maria Drangova and Dana Peters			
<i>Talk #</i>	<i>Time</i>	<i>Speaker</i>	<i>Title</i>
3.1	14h00	Georg Bongartz	Intra-arterial MR-angiography for the guidance of interventional MR: Theoretical considerations and practical applications in patients
3.2	14h08	Charles Dumoulin	Interventional MRA
3.3	14h16	Harald Quick	Interventional MRA with no strings attached: Wireless active catheter visualization
3.4	14h24	Reed Omary	Catheter-directed gadolinium-enhanced MR angiography
3.5	14h32	Michael Bock	Interactive parallel-imaging pulse sequences for active catheter tracking with real-time image reconstruction
	14h40	Discussion Period	
3.6	14h50	Stefan Petersson	Interventional MRS using hyperpolarized C-13
3.7	14h58	Alexander Dick	Invasive human magnetic resonance imaging: Feasibility during revascularization in a combined XMR suite
3.8	15h06	Kevin Mennitt	Optimizing MR angiography of racer stents
3.9	15h14	Ergin Atalar	Percutaneous MR-guided trans-caval catheterization of meso-caval venous system
	15h22	Discussion Period	
15h30 – 16h00 Break			
4. Coronary MRA – Chairs: Graham Wright and Gerhard Laub			
<i>Talk #</i>	<i>Time</i>	<i>Speaker</i>	<i>Title</i>
4.1	16h00	Jordin Green	Projection imaging of the right coronary artery with an intravenous injection of contrast agent
4.2	16h08	James Goldfarb	MR angiography of the cardiac veins
4.3	16h16	Dana Peters	Coronary MRI using radial balanced SSFP using a preparation phase
4.4	16h24	Pascal Spincemaille	Three-dimensional coronary MR angiography with cardiac fat navigator echoes
4.5	16h32	Jennifer Keegan	Interleaved spiral coronary artery blood flow
	16h40	Discussion Period	
4.6	16h50	Jong Park	Cardiac output measurement in <10 seconds using MRI
4.7	16h58	Yi Wang	4D Magnetic resonance angiography
4.8	17h06	Philip Yang	In vivo MR evaluation of the effects of mouse embryonic stem cells on cardiac function in acute myocardial infarction
4.9	17h14	Frank Prato	Myocardial stem cells therapy: Role of MRI
	17h22	Discussion Period	

Appendix III:
Minutes of the Management Board Meetings

**Ontario Consortium for Cardiac Imaging
Board Meeting
Elm Room, University of Toronto 89 Chestnut Residence
Tuesday, March 2, 2004 at 7:00 PM**

Minutes of the Meeting

Participants:

Graham Wright, Chair, Ontario Consortium for Cardiac Imaging
Rob deKemp, University of Ottawa Heart Institute
Maria Drangova (Janet Wallace), Robarts Research Institute by teleconference
Heather Phillips, GE Medical Systems Canada
Frank Prato, Lawson Health Research Institute
Shi-Joon Yoo, Hospital for Sick Children
Susan Murley (Jennifer Pohl by teleconference), Special Projects – Research, SWCHSC
Perry Radau, Technical Director, Ontario Consortium for Cardiac Imaging

Absent:

Michael Boyle, Communications and Power Industries
Naeem Merchant, University Health Network
Terry Ruddy, University of Ottawa Heart Institute
Gerald Wisenberg, Lawson Health Research Institute

1. Welcome and Introductions

Graham Wright opened the meeting and thanked all members for taking the time to participate. Members of the Board were identified for the benefit of those participating by teleconference.

2. Approval of Agenda

Frank Prato motioned approval of the agenda, seconded by Heather Phillips. VOTE: unanimously passed.

3. Review and Approval of Minutes from the Last Meeting

Rob deKemp referred to Item 6 (Finance Control and Fund Redistribution Policies) of the minutes of the December 18, 2003 Board Meeting and requested the term “first occurrence” be amended to read “first occurrence as detailed in the financial policy”. For the record, Policy II (Deviations from Budgeted Spending Targets and Reallocation of Funds), Paragraph 3 states,

“If an institution does not meet the benchmark for the year, a warning will be issued to the institution. If an institution does not meet the benchmark for two consecutive years, then the OCCI Board will consider whether it should make a finding that an event of default has occurred according to section 9.2 of the Inter-Institutional Agreement. In considering this finding, the Board should make a full investigation of the circumstances surrounding the underspending,

which may include sending Board members to the institution, to see if the contract milestones and hiring targets are being met.”

Spending benchmarks are as follows:

- Year ending December 31, 2003 – spending at 80% of the budget target to that date calculated using a 6-year budget
- Year ending December 31, 2004 – spending at 85% of the budget target to that date calculated using a 6-year budget
- Year ending December 31, 2005 – spending at 90% of the budget target to that date calculated using a 6-year budget”

Frank Prato motioned approval of the minutes as amended, Rob deKemp seconded. VOTE: unanimously passed.

4. Updates on ORDCF Policies and Audit Report

Susan Murley advised that as a result of the Provincial Audit Report on Government Spending, the ORDCF has developed overly complex policies and procedures that have resulted in a request for increased levels of documentation from all institutions and their partners. As a result, the institutions have expressed their concern in requesting the increased level of documentation, and in particular, from the private sector partners.

An ad-hoc working group, consisting of the representatives of the VPs of Research from Sunnybrook & Women’s and the Universities of Toronto, McMaster, Ottawa, Queens, Waterloo, and Western Ontario, is working with the ORDCF to prepare and review new ORDCF policies and to discuss the proposed new documentation requirements. This working group is supported by the Council of Ontario Research Directors (CORD) and the Ontario Council on University Research (OCUR). A request to meet with Mark Dietrich of ORDCF to discuss the draft policies has been made and the date set for March 22nd. Once approved by all parties, they will be distributed to all institutions supported by ORDCF funding.

5. Budget Review

a. Expenditure Analysis

Susan Murley provided a brief summary of the expenditure analysis for other institutions, with exception of Lawson, up and including December 2003.

Frank Prato advised that an additional finance person had been hired and is in training. Susan Murley offered to provide assistance with training. Financial analysis to be done at next meeting after Lawson has filed.

b. Expenditure Analysis – Core Budget

Susan Murley reviewed the Core Budget up to December 31, 2003 and based on the projections of a 6-year budget, \$168,090 will be available in unallocated funds at the end of the project.

Graham Wright announced that two multi-institutional PDF positions were awarded for the December 2003 competition: Kevin Sprague at the University of Ottawa Heart Institute and

Labonny Biswas at the Hospital for Sick Children. Each award is for \$40,000 per year, plus \$2000 for travel expenses.

Discussion followed on the number of PDF positions to be considered for future funding based on the available unallocated funds. The current allocation for multi-institutional PDFs is limited to 2 positions per year. There is potential for another competition in June that would result in 2 ½ positions funded in 2004. With agreement from Frank Prato and Rob deKemp, Graham Wright motioned that \$36,000 of unallocated funds to be allocated to the support of multi-institutional PDF program; seconded by Frank Prato. VOTE: unanimously passed.

Janet Wallace suggested that a portion of the unallocated funds be reserved for the SPO to wrap up the OCCI project. Susan Murley suggested an allocation of \$10,000.

c. Payment Flow from ORDCF

Susan Murley commented on the ORDCF allocation shortage from the Provincial Ministry that resulted in a lack of project funding during the Fall of 2003. ORDCF requested an increased allocation for 2003/2004 and are waiting for a response from the Ministry. Based on the funding decision, funds should flow either in mid-March or April.

In addition, unless the Ministry allocates additional funds 2003/2004 by, the same occurrence may happen in 2004/2005. Currently the OCCI July - December 2003 payment is 3 months behind. An email message from Susan Murley was sent to the institutional finance personnel notifying them of the situation.

Janet Wallace commented on the financial burden that has resulted at Robarts, and the impact on hiring and milestones. Janet also questioned if the flow of funds from the Research Performance Fund would be affected, as RPF is generally paid on funds actually distributed in the fiscal year. Susan Murley advised that she would take Janet's comments to the Working Group. Graham Wright questioned the need for bridge funding to carry over the projects until ORDCF funds are distributed. In response, Maria Drangova requested that either an Executive Committee or Board Meeting be scheduled if funds are not received by April 2004.

d. Private Sector Issues: Schedule F

Susan Murley stated that the Schedule F must be updated yearly. Teleconference call was held with Frank Prato and Brenda Dubois and the outstanding issues are still in effect at Lawson.

6. OCCI Annual Report to ORDCF

Susan Murley advised that Jennifer Pohl submitted the OCCI Annual Report to ORDCF on March 1, 2004. Graham Wright will review the report, including publications, for distribution to the institutions in the hope that it may encourage response for collaborative research opportunities. Milestones were met. Susan Murley commended HSC and UOHI on the content of their reports.

Heather Phillips advised that Private Sector partners must submit to Revenue Canada a brief description of the research they are involved in and requested the Annual Report be released to the partners. Graham Wright will circulate the report to Board first, and pending approval, the report can be a public document on the website. Proprietary material will be removed from the public report by the Board.

7. **OCCI New Membership**

Graham Wright stated that the membership list is static, and suggested that a mechanism be put in place to encourage the recruitment of young investigators. Discussion followed.

Rob deKemp commented that the idea was an excellent way to promote collaboration and suggested that it become part of the Annual Report. New investigators should be encouraged to bring in new partners; however they would not receive funding unless reallocated despite the access to core resources. Frank Prato stated his support for bringing on additional collaborators from different sites. Other centers were originally sought, and this would be a mechanism for achieving the goal.

Rob deKemp questioned the required qualifications and Graham Wright responded that the new investigator must be recognized as a potential PI for grant applications to HSF or CIHR. Potential candidates include: Sandy Dick (S&W), Anne Martel (S&W), Chris Macgowan (HSC), Marshall Sussman (UHN), Jean DeSilva (UOHI) and Ben Chow (UOHI).

Frank Prato requested that Gerald Moran (McMaster) be considered. He is currently collaborating with Frank Prato and Terry Thompson, and would join the OCCI through Lawson. Discussion followed regarding potential problems, i.e. – multi-institutional PDFs between new institution and host institution would be not be permitted.

Benefits to New Investigator:

- CV would be included in the OCCI Annual Report under the host institution
- Listed as an investigator on the OCCI website
- Participation at OCCI-sponsored workshops

Benefits to Consortium:

- Embracing the consortium and making a contribution to OCCI.
- Expenses would be billed through Host institution by invoice (only ORDCF money) and could count as a new hire
- No new private sector funding could be counted

Mechanism for New Investigators Recruited from an Institution Within the Original Consortium:

Since resources flow through the institutions, the new investigator must be sponsored by a PI within the original consortium. New investigators will provide a CV and a brief letter outlining their research, along with sponsorship letter from the nominating PI, which will be submitted to Board for approval.

Mechanism for New Investigators Recruited from an Institution Outside the Original Consortium (Status Only):

New investigators recruited from an institution outside the original consortium will have status only and will not have the ability to draw funds from the OCCI but could attend and submit papers to workshops and symposia. They will provide a CV and a brief letter outlining their research, along with sponsorship letter from the

nominating PI (must be one of the original investigators in the Consortium), which will be submitted to Board for approval.

Graham Wright motioned approval of the mechanisms for recruiting new investigators, seconded by Frank Prato. Maria Drangova abstained. VOTE: Passed.

Heather Phillips questioned if other INO consortia should be made aware of this new policy and was advised that the policy would have to be submitted to the INO Board for approval.

8. Multi-Institutional PDF Competition – June 2004

Graham Wright announced that the next deadline for the competition of 1 position would be held in June. Funding would be for one year with renewal upon application. Next competition deadline date will be December 1, 2004.

9. INO Symposium 2004 and Future Workshops

Graham Wright acknowledged the beginning of Imaging Network Ontario Symposium on March 3rd and announced the following:

- OCCI program to be held on the afternoon of March 3rd
- Perry Radau will conduct a brief workshop on March 3rd at 5PM in the St. George Room (3rd floor)
- Maria Drangova will judge posters

Graham Wright commented that 3 workshops per year are required as an OCCI milestone, Co-sponsorship of an event will provided for up to \$10K, based on open attendance by the OCCI membership. Proposals are to be prepared for the following:

- Shi-Joon Yoo to conduct a one-day OCCI workshop in conjunction with the American Pediatric Radiology Association. Proposal to be submitted for Board review.
- Maria Drangova suggested a workshop held in conjunction with the MRA club in September. Proposal to be submitted for Board review.

10. Update: Website Project

Susan Murley advised that the template has been put into HTML and available to view online. The EasyPublisher software allows designated users to input information on the editor. Once completed, forward to Christine Sudeyko for review and posting.

Items to be included in the creation of the new site (to be completed before the next Board meeting):

- Investigators who have moved to other institutions are to be removed
- New investigators to be added
- Page be created devoted to Granting Agencies
- Perry Radau to receive training and access as a designated user

11. Update: CIHR Clinical Trial Submission

Graham Wright advised that Gerald Wisenberg was waiting for a response from CIHR on the LOI submission.

12. Update: NIH Submission

Frank Prato advised that he was waiting for a response from NIH on the LOI submitted by Lawson, S&W, and St. Michael's Hospital.

13. Update: OCCI Strategic Initiatives

Graham Wright provided a brief summary on the expected growth of the OCCI, stating that other funding opportunities must be identified, and within next year, a strategy developed for the collaborations to be continued.

Susan Murley commented that the options investigated:

- CIHR Industry Partnerships: Mega Projects
- CIHR Proof of Principle Initiatives
- NIH

Discussion followed and the following were suggested for further investigation:

- Networks of Centres of Excellence
- Group efforts around the Regenerative Medicine theme (e.g. NIH application, New Emerging Teams application, McLaughlin Centre funds for Toronto institutions)
- CFI Innovation Fund IOF
- Medical Technology - Health Care Innovation, chaired by Henry Friesen, medical technology fund – Tofy Mussivand sits on the Board – Susan Murley to question Michael Julius about this opportunity.
- Seed funding through Canadian Medical Discoveries Fund Inc. (Cal Stiller is a Board member). (<http://www.cmdf.com/en/index.asp>).
- Spin offs such as clinical trials – evaluation of drugs, therapies, etc.

Graham Wright commented that a working group would be struck within the next 9 months to begin writing new applications.

Rob deKemp questioned if ORDCCF looked at milestones on the exit of the project. Susan Murley reviewed the milestones listed in the agreement and advised that no specifics or timelines were detailed.

Frank Prato questioned if involvement with the private sector partners might be worth considering – i.e. GE has positions available: 1 in London and 3 in Toronto. What is GE getting out of the ORDCCF projects with the money spent? Opportunities are to be identified.

Susan Murley questioned if IP should be inventoried (belongs to the institutions) and opportunities linked. Heather Phillips stated that this would aid in attracting new private sector partners, specifically marketing to new technologies since patented IP is important.

14. Other Business

No other business was discussed.

15. Future Meetings

Graham Wright motioned that the next Board Meeting be held in June 2004, Rob deKemp seconded. VOTE: Unanimously passed.

16. Meeting Adjourned

Graham Wright motioned the adjournment of the meeting, seconded by Frank Prato. VOTE: Unanimously passed. Meeting adjourned at 8:53 PM.

**Ontario Consortium for Cardiac Imaging
Board Meeting Teleconference Call
Tuesday, July 20, 2004 at 4:00 PM**

Minutes of the Meeting

Participants:

Graham Wright, Chair, Ontario Consortium for Cardiac Imaging
Michael Boyle, Communications and Power Industries
Maria Drangova, Robarts Research Institute
Heather Phillips, GE Medical Systems Canada
Frank Prato, Lawson Health Research Institute
Shi-Joon Yoo, Hospital for Sick Children
Susan Murley (Jennifer Pohl), Special Projects – Research, SWCHSC
Perry Radau, Technical Director, Ontario Consortium for Cardiac Imaging
Terry Ruddy, University of Ottawa Heart Institute

Absent:

Rob deKemp, University of Ottawa Heart Institute
Naeem Merchant, University Health Network
Gerald Wisenberg, Lawson Health Research Institute

1. Welcome and Introductions

Graham Wright opened the meeting and thanked all members for taking the time to participate.

2. Approval of Agenda

Terry Ruddy motioned approval of the agenda, seconded by Maria Drangova.

3. Review and Approval of Minutes from the Last Meeting

Heather Phillips motioned approval of the minutes from the last meeting as pre-circulated, seconded by Frank Prato.

4. Update: Finance and Administration

a. Expenditure and Contribution Analysis by Institution

Susan Murley provided a brief summary of the analysis by institution, up to and including March 31, 2004.

MOTION: Upon Motion made by Graham Wright and seconded by Terry Ruddy, it was resolved that if an institution shifts allocations within the four (4) major categories (Salaries and Benefits, Facilities Renovations & Equipment, Other Direct Research Expense, and Management Administration) by 20% of the institution's budget for that category, approval must be obtained from ORDCF before ORDCF funds can be distributed.

Vote: unanimously passed. MOTION CARRIED.

Susan Murley reiterated that the SPO will be monitoring spending benchmarks and reports will be made to the Board.

b. Core Budget Analysis

Susan Murley reviewed the Core Budget up to March 31, 2004 and based on the projections of a 6-year budget - \$294,441 will be available in unallocated funds at the end of the project of which \$36,000 will be allocated to the support of multi-institutional PDF program.

c. Extension of the Contract (due to 6-Year Budgets)

Susan Murley confirmed that the 6-Year Budgets have as yet not been submitted to the ORDCF for approval.

MOTION: Upon Motion made by Graham Wright and seconded by Frank Prato, it was resolved that revisions to the approved 6-Year Budgets be completed and submitted for approval by the ORDCF by October 30, 2004.

Vote: unanimously passed. MOTION CARRIED.

Maria Drangova requested copies of the revised budgets be distributed. Frank Prato requested a meeting be scheduled with Susan Murley and Jennifer Pohl in London in the near future.

d. Research Performance Fund Distribution

Susan Murley reviewed the formula used to determine the Research Performance Fund Distribution to the institutions.

MOTION: Upon Motion made by Frank Prato and seconded by Terry Ruddy, it was resolved that the calculation of the Research Performance Fund Distribution was accurate and that funds could be distributed to the institutions.

Vote: unanimously passed. MOTION CARRIED.

The SPO will distribute the Research Performance Funds to the institutions – Frank Prato requested that the cheque for Lawson Health Research Institute to be forwarded to his attention.

e. Audit Update

Susan Murley advised that the deadline (June 30, 2004) for obtaining the Audit Certificate had not been met and that the SPO was working on satisfying the requests of the audit team.

f. Update on Annual Allotment of Funds from MEDT to ORDCF

Susan Murley advised that despite the \$85M allocation ORDCF received from the Provincial Ministry for 2003/2004, the same occurrence may happen in 2004/2005. As a precaution, tighter timelines will be adopted for the reporting schedules and the institutions are requested to comply with the deadlines.

5. Multi-Institutional PDF Competition Award – June 2004

Graham Wright announced that the application submitted by Frank Prato and Rob Beanlands for the support of Katie Lekx had been approved. Funding would be for one year, commencing October 2004, with renewal upon application. Next competition deadline date will be December 1, 2004 – to be posted on OCCI website.

6. Future Workshops and INO Symposium 2005

Graham Wright reiterated that 3 workshops per year are required as an OCCI milestone. Shi-Joon Yoo advised that he would submit a proposal to conduct a one-day OCCI workshop to be held in conjunction with the American Pediatric Radiology Association meeting in Toronto in March 2005.

Susan Murley received favourable feedback on the INO Symposium 2004 from Terry Ruddy and Maria Drangova - same location and venue should be used for 2005.

7. Application for Funding: MRA Workshop

Graham Wright reviewed the request for funding (\$10K) prepared by Brian Rutt to support two scientific sessions (Coronary MRA and Interventional) being held in London from October 6 to 9, 2004. He advised that the OCCI-supported sessions would be open to all OCCI participants, including investigators, students, PDFs, and technicians, with a reasonable restriction on total number (~30 people). Registration for these sessions could be handled through the OCCI website.

MOTION: Upon Motion made by Graham Wright and seconded by Terry Ruddy, it was resolved that the funding to support two scientific sessions (Coronary MRA and Interventional) at the MR Angio Workshop 2004 in London be approved provided that the OCCI-sponsored sessions would be open to all OCCI participants with reasonable restriction on total number (~ 30 people).

Vote: unanimously passed. MOTION CARRIED.

8. Update: Website Project

Susan Murley advised that project was underway.

9. Update: CIHR Clinical Trial Submission

Graham Wright advised that the outline submitted for the CIHR Randomized Controlled Trials competition was declined and that a teleconference call would be scheduled in early September to organize another submission. Outline and registration deadlines are: October 1, January 15 and March 1 with application deadlines being November 1, February 15 and April 1.

10. Update: NIH Submission

Frank Prato advised that the decisions are to be made in August with the notice issued in September.

11. Technical Director's Office Update

Perry Radau provided a brief overview of the report, as circulated.

12. Update: OCCI Strategic Initiatives

a. Communications and Information Technology Ontario (CITO)

Susan Murley and Perry Radau provided a brief overview of the opportunities associated with CITO as potential leveraging for the Technical Office.

b. New Provincial Funding Opportunity

Susan Murley advised that currently there were no large scale funding opportunities available. Discussions with Mark Dietrich at the ORDCF revealed that Imaging Network Ontario, as a group, could submit a proposal to the provincial government for funding. Graham Wright requested that Susan Murley follow up on this opportunity.

13. Intellectual Property

To be reviewed by investigators. Comments are to be forwarded to Jennifer Pohl.

14. Other Business

No other business was put forward for discussion.

15. Future Meetings

Graham Wright suggested that the next meeting be scheduled for November 2004. Date and time are to be advised.

16. Adjournment

There being no further business, Graham Wright adjourned the meeting at 5:10 PM.

**Ontario Consortium for Cardiac Imaging
Board Meeting Teleconference Call
Tuesday, November 16, 2004 at 4:15 PM**

Minutes of the Meeting

Participants:

Graham Wright, Chair, Ontario Consortium for Cardiac Imaging
Michael Boyle, Communications and Power Industries
Rob deKemp, University of Ottawa Heart Institute
Maria Drangova, Robarts Research Institute
Heather Phillips, GE Medical Systems Canada
Frank Prato, Lawson Health Research Institute
Susan Murley, Special Projects – Research, SWCHSC
Perry Radau, Technical Director, Ontario Consortium for Cardiac Imaging
Gerald Wisenberg, Lawson Health Research Institute

Absent:

Naeem Merchant, University Health Network
Terry Ruddy, University of Ottawa Heart Institute
Shi-Joon Yoo, Hospital for Sick Children

Guests:

Chris Macgowan, Hospital for Sick Children
Marshall Sussman, University Health Network

1. Welcome and Introductions

Graham Wright opened the meeting and thanked all members for taking the time to participate. He introduced Chris Macgowan of the Hospital for Sick Children and Marshall Sussman of the University Health Network

MOTION: Upon motion made by Graham Wright and seconded by Frank Prato, it was resolved that Chris Macgowan (Hospital for Sick Children) and Marshall Sussman (University Health Network) would serve as designates representing their institutions on the OCCI Board.

Vote: unanimously passed. MOTION CARRIED.

2. Approval of Agenda

Rob deKemp motioned approval of the agenda, seconded by Maria Drangova.

3. Review and Approval of Minutes from the Last Meeting

Frank Prato motioned approval of the minutes from the last meeting as pre-circulated, seconded by Gerald Wisenberg.

4. New Investigators

a. Official status within Consortium

Graham Wright reviewed the mechanisms approved by the OCCI Board at the March 2, 2004 meeting and outlined below:

- ***Mechanism for New Investigators Recruited from an Institution Within the Original Consortium:***
Since resources flow through the institutions, the new investigator must be sponsored by a PI within the original consortium. New investigators will provide a CV and a brief letter outlining their research, along with sponsorship letter from the nominating PI, which will be submitted to Board for approval.
- ***Mechanism for New Investigators Recruited from an Institution Outside the Original Consortium (Status Only):***
New investigators recruited from an institution outside the original consortium will have status only and will not have the ability to draw funds from the OCCI but could attend and submit papers to workshops and symposia. They will provide a CV and a brief letter outlining their research, along with sponsorship letter from the nominating PI (must be one of the original investigators in the Consortium), which will be submitted to Board for approval.

Graham Wright advised that the mechanisms were distributed to the INO Operations Committee and Susan Murley advised that only two responses were received.

MOTION: Upon motion made by Graham Wright and seconded by Frank Prato, it was resolved that the mechanisms for recruitment of new OCCI investigators would be accepted, with the exception of attendance at the Symposium which will be subject to further response from the INO Operations Committee.

Vote: unanimously passed. MOTION CARRIED.

Nominations for new investigators must be forwarded to Christine Sudeyko (christine.sudeyko@sw.ca) by January 15, 2005. Material will be distributed electronically to the OCCI Board for their approval so that New Investigators can be included in the INO Symposium.

b. Use of New Investigator's Peer-Reviewed Grants as Institutional Inkind

Susan Murley confirmed that peer-reviewed grants awarded to the new investigators could be used as OCCI institutional inkind provided that:

- 1) the grants were not used as match on any other project, and
- 2) the grants have specific goals and aims that were aligned with those of the OCCI milestones.

5. Multi-Institutional PDF Competition Award

Graham Wright provided an overview of the program:

- Katie Lekx, Lawson Health Research Institute, Year 1 commencing October 1, 2004
- Labonny Biswas, Hospital for Sick Children, Year 1 ending December 2004 – Chris Macgowan will submit renewal application for funding of Year 2 (January to December 2005)
- University of Ottawa Heart Institute – Funding for 2 years has been received. Rob deKemp expressed interested in continued funding and was advised to submit as a New Applicant.

- Competition deadline revised to December 15, 2004.

6. **Future Workshops and INO Symposium 2004**

Graham Wright advised that Shi-Joon Yoo, Hospital for Sick Children, had submitted a request for workshop funding to support The Symposium on Advanced Pediatric Cardiovascular MR (April 2-3, 2005 at the Hospital for Sick Children). Discussion was held regarding co-sponsorship of the event.

MOTION: Upon motion made by Graham Wright, and seconded by Marshall Sussman, it was resolved that the OCCI would fund up to the amount of \$8,000 providing that the HSC Radiology Department co-sponsored the event and that OCCI members (approximately 20) be permitted to attend the event at no charge.

Vote: unanimously passed. MOTION CARRIED.

Maria Drangova provided a brief overview of the Interventional and Coronary MRA Workshops held October 6th in London in conjunction with the *16th International Workshop on Magnetic Resonance Angiography*.

Graham Wright reiterated the need for OCCI to sponsor 3 workshops per year (as a milestone), and encouraged applications for funding to be submitted for workshops held in 2005.

Graham Wright advised that Frank Prato and Sandy Dick had agreed to serve as the Scientific Advisors, providing assistance to the INO Planning Committee with the development of the ½ day OCCI program. Frank Prato advised that the program would be on Myocardial Regeneration and Stem Cells.

7. **Update: Website Project**

Christine Sudeyko was advised by the Board to transfer all material from the old website to the new website. Information requests for updates on Scientist Profiles to be included with the Annual Report template, to be distributed in December. New Investigators application should include profile for website.

8. **New Funding Opportunities**

a. **CIHR New Emerging Team Grants**

Frank Prato advised that a LOI, entitled *Towards Image Guided Myocardial Stem Cell Therapy: Molecular Imaging, Nanotechnology and Stem Cell Biology*, was submitted November 1st on behalf of Frank Prato, Graham Wright, Alexander Dick, Margaret Hough and Glenn Wells. The deadline for the grant submission will be May 1, 2005 with funding up to \$300,000 per year for a maximum of 5 years.

b. **CIHR Randomized Clinical Trials**

Gerald Wisenberg advised that the LOI was revised and forwarded to Yves Bureau for his comments. Document will be distributed to the remainder of the group shortly. LOI will be submitted in January 2005.

c. Communications and Information Technology Ontario

Perry Radau advised that the OCCI submission did not meet the October 19th deadline and that it will be complete for the March 2005 date.

d. CIHR Team Grant Program

Susan Murley summarized the pre-circulated document “New Funding Opportunity: CIHR Team Grant Program”, emphasizing that the LOI (consisting of 5 pages of scientific material, plus references) would be due January 7, 2005. Discussion was held and Graham Wright requested that those interested in submitting an application under the OCCI umbrella forward an email to either graham.wright@sw.ca or christine.sudeyko@sw.ca.

9. Technical Director’s Office Update

Perry Radau provided a summary of the pre-circulated document “OCCI Technical Office Progress Report” dated November 12, 2004, highlighting the following:

- New version of OCCIviewer (1.0.4) released.
- Hire of Desmond Chung on September 1, 2004.
- Development of XAR tool.
- Nick Hu has completed a new version of the real-time MRI viewer (RTviewer) and is now a half-time employee of the OCCI.
- An InfoRAD exhibit and seminar has been accepted and developed for RSNA to demonstrate the RTviewer.
- Negotiations are underway with Novadaq to develop software to operate their fluoroscopy system.
- Application for the Research Partnership Program of CITO/OCE will be submitted for the March 2005 round.

10. Update: OCCI Strategic Initiatives

a. Proposed New Provincial Government Funding

Susan Murley provided a summary of the pre-circulated document “Proposed New Provincial Government Funding”. Frank Prato requested that Research and Commercialization Strategy, prepared by the Ministry of Economic Development and Trade, be distributed as well.

11. Other Business

Graham Wright commented on his discussions held with Dr. Matthias Friedrich, a cardiologist in Calgary, regarding building links across Canada related to Cardiac MR.

12. Next Meetings

Graham Wright suggested that an OCCI Board Meeting be held in conjunction with the INO Symposium 2005 (scheduled for March 1-3, 2005) in Toronto. Date and time will be confirmed.

13. Adjournment

There being no further business, Graham Wright adjourned the meeting at 5:15 PM.