

DEPARTMENT OF RADIOLOGY **STRATEGIC PLAN** 2018 – 2023

Imaging the future of health



UNIVERSITY OF CALGARY CUMMING SCHOOL OF MEDICINE Department of Radiology

VISION

To lead improvements in health through advanced medical imaging

MISSION

Advance health and knowledge locally and globally through the development and application of innovative and impactful precision medical imaging

OUR CORE VALUES

EXCELLENCE

Recognizing the critical role of imaging in advancing health, members commit to the highest standard of research, education, and care.

INNOVATION

Innovation is at the heart of imaging. The Department challenges the status quo by supporting the development of novel, cutting-edge imaging solutions to the most pressing health challenges.

KNOWLEDGE

Encouraging continuous development of members, providing a world-class education and training environment and creating opportunities for knowledge exchange with the broader community.

COLLABORATION

Connecting complementary strengths and building multidisciplinary teams to enable innovative, solutions-driven imaging approaches in research, education, and care.

DIVERSITY

Creating an open and inclusive environment, recognizing that true success is achieved by embracing diversity in people, in thought, and in approach.

STRATEGIC PLAN, 2018-2023

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MESSAGE *from the* DEPARTMENT HEAD

Never before has the Department of Radiology been in such a unique and enviable position. Over the past two decades, we have witnessed unprecedented growth in advanced imaging technology in medicine. When coupled with the discovery of new imaging techniques and the expansion of innovative functional imaging methods and image-guided therapies, the opportunities for the Department appear limitless, and the time for Precision Imaging is now.

The recognition of such potential is evident by the substantial investments made in imaging over the past two decades. Government, industry, and philanthropy have a long history of successful partnership with Radiology and investment in clinical and research imaging infrastructure, dating back to the inception of the Seaman Family Magnetic Resonance Research Centre (SFMRRC) in 1999, the Experimental Imaging Centre (EIC) in 2002, the Stephenson Cardiac Imaging Centre (SCIC) in 2005, and the Child and Adolescent Imaging Research (CAIR) Program in 2013. In addition, close to \$30M has been invested in the Precision Imaging platform by the Cumming Medical Research Fund (CMRF), Government, the University of Calgary and philanthropy since 2015. Radiology has also witnessed significant investment in personnel in recent years. The Division of Image Science, consisting of the Department's PhD scientists has grown from 4 members in 2012 to 13 members and over 40 trainees in 2018. Similarly, our clinical faculty has experienced tremendous growth in the past decade, necessitated to respond to increased clinical demand for subspecialty imaging interpretation 24/7/365 and to support our Royal College-accredited Radiology Residency and Neuroradiology Residency Training Programs, as well as our imaging fellowship programs.

By 2017, the Department of Radiology had grown into an essential platform for research, innovation, education and care. Our members and infrastructure had evolved into a catalyst for collaboration, uniting like-minded individuals across clinical Departments, Institutes and Faculties at the University of Calgary, nationally and internationally. But where would we go from here? The Department was at a crossroad...

Do we stay the course and wait for new opportunities? Or be intentional; set lofty goals, define the path forward and control our own trajectory? The overwhelming consensus was the latter! It gives me tremendous pleasure to present to you the Department of Radiology's Strategic Plan 2018-2023, Imaging the future of health. The result of 30+ interviews with key stakeholders, a 2-day strategic planning retreat and input and feedback on numerous iterations by key individuals and stakeholder groups, this ambitious plan is a framework for excellence and success. The plan builds on our strength in people. It maximizes historical investments and nurtures existing partnerships, while leveraging new opportunities, future collaborations, and fostering innovation. This strategic plan is a template for growth and sustainability, guiding renewal and maintenance of aging infrastructure while expanding our service to meet the future demands of the Department, the CSM, and the university by ensuring we remain at the forefront of technology. It preserves the culture that has made us successful, but recognizes an opportunity to provide additional support for trainees, faculty and staff through mentorship and new approaches to maximize personal and professional growth and development. It capitalizes on existing partnerships, yet prepares us for the opportunities afforded by precision medicine, big data, and the evolving imaging paradigm embedded in machine learning and artificial intelligence.

I look forward to executing the details of this plan as outlined in the following pages and embracing the opportunity to *Image the future of health*.

Richard E. A. Walker, MD, FRCPC

Associate Professor and Head, Department of Radiology Cumming School of Medicine, University of Calgary Zone Clinical Department Head, Diagnostic Imaging Calgary Zone, Alberta Health Services





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EXECUTIVE SUMMARY

The academic Department of Radiology is a platform that spans the University of Calgary, with applications along the spectrum of health and wellness and across multiple faculties, departments, institutes, and centres.

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The multidisciplinary and collaborative nature of medical imaging is a strength and an opportunity, and highlights the role of the Department as a leader and catalyst in breaking down silos to harness the true potential of partnership.

More than ever, the Department of Radiology is positioned not only to elevate the impact of its own work, but of the Cumming School of Medicine and the University of Calgary as a whole. The Department of Radiology 2018-2023 strategic plan represents the collective voice of the diversity of clinical and academic faculty, trainees, staff, and stakeholders who contributed to its development. Through consultations, planning sessions, surveys, and a Department retreat, we captured the aspirations and potential for medical imaging in Calgary and gained clarity around the Department's strengths, where there is room for improvement and, ultimately, the transformational impact that can be achieved by working together toward a common vision.

This plan has been designed to be both aspirational and achievable. A bold vision. coupled with specific and achievable actions, will set the path toward excellence in research, education, and health. Guided by the University of Calgary's Eyes High strategic vision and the Cumming School of Medicine's strategic plan 2015-2020, the Department of Radiology is embarking on a journey to achieve its vision to lead *improvements in health through advanced* medical imaging via its mission to advance health and knowledge locally and globally through the development and application of innovative and impactful precision medical imaging. Over the next five years, the Department's activity will be driven by three overarching goals to fulfill its mission and achieve its vision



These goals were developed through a lens of excellence and collaboration. By capitalizing on its strengths and aligning with its partners and collaborators in priority areas, the Department of Radiology is ready to embark on an ambitious journey to lead improvements in health through advanced medical imaging.

GOAL 1

Establish the Department of Radiology as a globally recognized centre for excellence and innovation in research, education, and care in precision medical imaging.

Given the role medical imaging can play in precision health, the Department of Radiology is in a position to use the University of Calgary and Cumming school of Medicine's priority in this area as a springboard to global impact. The collective potential of cuttingedge technology, attracting and retaining the best and brightest minds, a sustainable model for growth, and an environment that fosters collaboration from bench to beside will enable the Department of Radiology and University of Calgary to be a stronger and more impactful contributor on the national and international stage.

GOAL 2

Enrich the education, training, and knowledge translation experience for faculty, staff, graduate students, fellows, and residents to position them for success as global thought leaders and innovators.

Education and research are at the core of the University of Calgary's mission, and success is measured through the accomplishments of trainees, the successes in their careers, and the impact of their discoveries on humankind. For the Department of Radiology to truly achieve its vision, it must invest in the education, training, and development of its current trainees, staff, and faculty and in establishing a strategy for attracting the best and brightest minds to Calgary. By developing a trainee-centred approach and leveraging existing opportunities, the Department can distinguish itself as a destination for value-added education. training, and knowledge translation in radiology.

GOAL 3

Enhance the existing partnership model with other Departments, Institutes, and industry that leverages complementary strengths and positions the Department as both a Centre of research excellence and an accessible research platform that catalyzes innovation from discovery to translation.

The Department of Radiology has a unique opportunity to expand upon its role as a University-wide platform, enabling integration of diverse perspectives to drive excellence in research and innovation. To truly harness the potential of this platform. though, requires awareness of opportunities across the University, knowledge of the value of medical imaging, alignment across partner priorities, and clear paths to access expertise and services. Furthermore, the Department must look beyond the University to strengthen its partnerships with the health system and industry to create a pathway for translation and implementation of research as well as a robust mechanism for continuous feedback. By formalizing its role as a platform and catalyst, the Department of Radiology is positioned to elevate the University's collective role as a leader and innovator in precision medical imaging.

BACKGROUND

The Department of Radiology is one of twenty academic Departments in the Cumming School of Medicine at the University of Calgary, offering worldclass educational, clinical, and research opportunities for students and faculty. The Department also serves as a bridge between the University of Calgary and Alberta Health Services, enabling a precision medical imaging platform to catalyze innovation from discovery to translation and back again. The following pages tell the story of the Department as it is today and the collective vision for the future, driven by a strategic approach that harness the incredible potential of the Department and its partners to lead improvements in health through advanced medical imaging.

RESEARCH, EDUCATION, AND CARE

RESEARCH

The Department of Radiology's precision medicine research focus aligns with that of the Cumming School of Medicine and University of Calgary. The Department aims to create, evaluate, and deploy the next generation of medical imaging techniques that can identify specific patient and disease characteristics that allow personalized treatments targeted at specific structural, functional, and molecular characteristics of each patient to optimize clinical outcome. Central to achieving this vision is collaborative cross-disciplinary research.

The Image Science Division is the basic research arm of the Department of Radiology that brings together imaging scientists across the spectrum from neuro to musculoskeletal, to cardiovascular, to paediatrics. Under the leadership of Division Head Dr. Bruce Pike, the Image Science Division has seen tremendous growth in the past five years, growing from four to 13 full-time members. The young, energetic and diverse membership are leading the research-informed innovations within the department and training the young scientists in the development and application of medical imaging methods.

CSM PRIMARY INSTITUTE AFFILIATION

(Full & Associate Academic Faculty)



Research within the Department of Radiology includes, but is not limited to, the following areas:

- Paediatrics: using multiple imaging methods to understand healthy brain development and developmental disorders, recovery from brain injury, cognitive and behavioral function and dysfunction, treatments, and interventions.
- **Musculoskeletal:** imaging and modeling of bone that focuses on using novel technologies and analysis methods for better diagnosis and monitoring of diseases such as osteoporosis and osteoarthritis.
- Structural and Functional Brain Imaging: for example, in epilepsy, multiple sclerosis, Parkinson's disease, Alzheimer's disease, and mental illnesses
- Stroke and Vascular Disease: imaging applications to the understanding, early diagnosis, and intervention of vascular diseases, including stroke and vascular dementia.
- Cardiac Imaging: research focused on the performance, development and training of cardiovascular MRI techniques, working to improve patient outcomes through discovery and innovation in the field of cardiovascular image-guided therapy.
- **Pre-Clinical Animal Modeling:** developing and applying imaging technology to study disease models and translate technology to patient care.



- **Computational Neuroscience:** development and identification of computational models of brain activity to clarify how the signals recorded in neuroimaging and electrophysiology are generated and how they can be used understand neurological diseases.
- Machine Learning and Artificial Intelligence: development and application of new image processing methods, algorithms, and software tools for the analysis of medical images; including image-based extraction of clinically relevant parameters and biomarkers describing the morphology and function of organs.



EDUCATION

The Department prides itself on offering outstanding education in a state-of-theart training environment at all levels within the University, including undergraduate, graduate, postdoctoral, residency, and clinical fellowships.

Undergraduate Medical Education

Radiologists from the Department of Radiology provide instruction in the fundamentals of clinical radiologic imaging anatomy and image interpretation to medical students at the University of Calgary as part of the undergraduate medical education curriculum. This is accomplished through large classroom instruction integrated with core lectures, small group tutorials, development of supplementary materials such as podcasts and through mentorship programs. Two-week clerkship elective opportunities in Radiology are also offered at several hospital sites across the Calgary Zone for those students interested in additional exposure to diagnostic imaging or who are considering postgraduate training in Radiology.

Graduate and Postdoctoral Training

The Department of Radiology has had a major impact on the development of graduate science training in medical image science over the last two decades. Starting in 2001 when the first graduate course in medical imaging was offered, this effort has grown into four routinely offered graduate courses, a dedicated graduate specialization in Medical Imaging, as well as recently hosting a successful NSERC CREATE* program.

From its inception, the research effort of the Department of Radiology has involved the training, through research, of graduate students and post-doctoral fellows. Our image scientists typically directly supervise between 2 to 8 trainees, often augmented in the summer by 1-3 summer students. Currently there are approximately 40 graduate students and postdoctoral fellows, plus numerous undergraduate students conducting research in the Department. Our graduate training efforts are in full partnership with a number of graduate programs, primarily including Biomedical Engineering, Medical Science and Neurosciences. The Department hosts a vibrant Advanced Imaging Seminar Series weekly from September to June and each spring, it plays host to the Alberta Imaging Symposium, a research symposium that attracts over 150 attendees primarily from Alberta universities and medical imaging industry.



Faculty members in Radiology routinely offer graduate courses under the MDSC 689 course family. These include:

- MDSC 689.01 Medical Imaging Techniques
- MDSC 689.02 Advanced MR Imaging
- MDSC 689.03 Advanced Medical Image Processing
- MDSC 689.11 Medical Imaging Applications

Two other graduate courses have been offered in the past decade – MDSC 689.04 – Advanced Molecular Imaging (twice) and MDSC 689.10 – Medical Imaging Theory (twice), and may be offered in the future.

* Natural Sciences and Engineering Research Council - Collaborative Research and Training Experience Program



The Medical Imaging Graduate Specialization (MEDI) is coordinated by the Department and is offered to MSc and PhD students in the Biomedical Engineering, Electrical Engineering, Medical Sciences, Neurosciences, Psychology and Physics and Astronomy graduate programs. Each year, approximately 10-15 graduate trainees enrol in this program, primarily through Biomedical Engineering. To be awarded the specialization students must complete course work (MSc: MDSC 689.10 and one of MDSC 689.10 or 689.11; PhD: MSc course plus one additional Medical Imaging course), attend and present annually in the Advanced Imaging Seminar, and produce and successfully defend an appropriate thesis on a medical imaging topic.

From 2012-2018, the Department hosted a Collaborative Research and Training Experience (CREATE) program grant from NSERC. Our CREATE International and Industrial Imaging Training (I3T) Program was extremely successful in further enhancing the research training efforts within medical imaging. With NSERC funds, we were able to partially support, for 1-year periods, over 140 trainees – 15 undergraduates, 85 graduate students (both MSc and PhD) and 43 postdoctoral fellows. Additionally, the CREATE I3T program supported 21 trainees exchanges from Calgary and 4 international trainees exchanges to Calgary, three multi-day workshops, and a unique professional skills development program.

Radiology Residency Training Program

The goal of the Diagnostic Radiology Residency Program at the University of Calgary is to prepare the next generation of physicians to become highly skilled clinical radiologists while also teaching the skills required to excel in research, education, and innovation in the field of diagnostic imaging.

Each year the Diagnostic Radiology residency program at the University of Calgary accepts 5 incoming residents through the CaRMS match and currently there are 27 residents in training. Over the past 10 years the number of positions has remained fairly constant, fluctuating slightly from a minimum of 4 residents per year to a maximum of 6 residents per year to meet ongoing demands in the practice of Diagnostic Radiology and changes to the standards of training from the Royal College.

The University of Calgary Diagnostic Radiology Residency Program is a dynamic, resident driven program with state of the art facilities, subspecialty-trained staff and exposure to a wide spectrum of pathology. There are many specific features that draw exceptional candidates from across the country to train here in Calgary. First, the Diagnostic Radiology Visiting Professor program has been a huge success over the years. World-renowned experts in radiology and authors of the classic and innovative textbooks fundamental to radiology are invited 3-4 times per year to teach the residents over a two-day period. All residents are excused from their clinical duties to attend. This allows the residents to be taught by experts and access the best radiology teachers and educators in the world. It also allows residents to connect with experts from major teaching centres, which has opened doors to highly competitive fellowships in the past. Over the past few years our residents have successfully obtained fellowships at Harvard University, Stanford University, the University of Washington, the Barrow Neurological Institute, University of Toronto, University of Ottawa, University of Calgary, University of Alberta, University of Halifax, among others. Second, the University of Calgary Diagnostic Radiology program is the only training program in the country to offer a Senior Resident Radiology Clinic in which a senior resident has the opportunity to work independently, as the only physician on site, in a community radiology clinic. This opportunity allows senior residents to gain confidence and independence as they transition to their role as a radiologist with appropriate staff back up available if needed. Additionally, this clinic allows for exposure to fundamental community radiology that is often a large component of a radiologists practice but may not be otherwise represented through training that typically occurs in tertiary referral hospitals. Innovations like the Senior Resident Radiology Clinic will be important components in the future as Diagnostic Radiology programs across Canada transition to Competency Based Medical Education.



Participation in scholarly work is a mandatory component of radiology residency training at the University of Calgary. Each resident will undertake two projects during the course of their training. The first mandatory requirement is an audit project. This is fundamentally a quality assurance/ improvement (QA/QI) exercise, but also serves as an introduction to research techniques, including data gathering, analysis, and presentation. This is typically presented at the end of the PGY2 year at the annual Department of Radiology Research Day, but presentation at a conference or publication is also encouraged if applicable. The second mandatory requirement is a formal investigative project, preferably hypothesis driven research, with the aim for publication in a refereed radiology journal or presentation at a major radiology conference in North America.

This is also typically presented at the end of the PGY4 year at the annual Department of Radiology Research Day. Through close ties with our clinical counterparts in various subspecialty areas of Radiology and in collaboration with the Division of Imaging Science, there are many research opportunities available to trainees. Depending of their level of interest, many residents participate in multiple research projects during their training. The Diagnostic Radiology Residency Program and Post Graduate Medical Education Office assists with the costs of travel and accommodations for any resident that has had their work accepted for presentation at major conferences.

Clinical Fellowship Programs

Currently, the University of Calgary Radiology Fellowship program offers a broad spectrum of fellowship positions in almost all programs with the annual number of applications and enrollment increasing. Our fellows come from across the globe, currently split 1/3: 2/3 between Canadian Medical Graduates and International Medical Graduates. The program underwent a recent amalgamation of administration with the residency program, which has led to uninform processes and policies with cross pollination and coordination of activities between multiple training levels. Fellows currently train at Foothills Medical Centre (including the Tom Baker Cancer Centre) and Alberta Children's Hospital, providing a subspecialty practice environment and a breadth of scholarly activities and academic rounds within a given radiology subspecialty. Currently, only the Neuroradiology Fellowship program is RCPSC accredited. While the Neuroradiology program is the second largest in Canada and best known for a wellestablished research and training environment, the other programs are smaller and less well known outside of the region as many have only started within the last 5 years and do not have the same profile as an accredited program.

In the future, the fellowship program will continue to develop formal curricula for each subspecialty area, further defining educational goals, objectives and evaluation methods. We will prioritize seeking RCPSC accreditation for our all programs as more radiology subspecialties become accredited by the Royal College. We will also strive to raise the profile of the non-accredited programs by encouraging and facilitating Faculty development, increasing research involvement and enhancing international exposure by way of publications, presentations, and web presence.

Through our Faculty's commitment to education, continuously growing patient population, excellent infrastructure and well-trained fellows, who will serve as ambassadors for our programs, we have all of the ingredients to build one of the best radiology fellowship programs in Canada. The Department of Radiology currently offers the following clinical fellowship opportunities:

- Abdominal/Body Imaging
- Body Interventional
- Cardiac and Thoracic Imaging
- Diagnostic Neuroradiology*
- Emergency Radiology
- Interventional Neuroradiology
- Musculoskeletal Imaging
- Obstetrical/Fetal Imaging
- Pediatric Radiology

* Fully accredited by the Royal College of Physicians and Surgeons of Canada



CLINICAL CARE

Diagnostic Imaging in the Calgary Zone, Alberta Health Services consists of 4 large adult urban hospitals, an academic acute care children's hospital and tertiary pediatric referral site for southern Alberta. 7 suburban/ rural hospitals, 4 urgent care centres and a community diagnostic and treatment centre. Foothills Medical Centre (FMC), a tertiary acute care facility is home to the Zone's level 1 trauma centre, neurosurgery, cancer care, and the Calgary Stroke Program, and is a major academic referral centre for southern Alberta and southeast British Columbia. The Zone is well equipped with some of the most advanced imaging equipment available today, including 3 clinical and 2 cardiac 3 Tesla Magnetic Resonance Imaging (MRI) scanners, numerous 64-slice Computed Tomography (CT) scanners and a state-of-the-art 256-slice CT scanner at FMC supporting the demands of trauma and acute stroke. FMC also houses the Calgary Zone positron emission tomography (PET) program and an integrated, advanced diagnostic and contrast-enhanced ultrasound (CEUS) program. Advanced diagnostic and therapeutic body, vascular and neurointerventional imaging suites, CT SPECT, diagnostic ultrasound, x-ray, digital fluoroscopy and multipurpose rooms, mammography, and dual energy x-ray absorptiometry (DXA) equipment rounds out the complete spectrum of imaging infrastructure in the Zone.

MEDIAN TURNAROUND TIME FOR EMERGENCY CT/GR/US FOR CALGARY ZONE

April, 2017 - March, 2018



The Calgary Zone delivers one of the most comprehensive, subspecialty diagnostic imaging service provisions in Canada, including extended hours for X-ray, ultrasound and advanced imaging, with real-time interpretations 24/7/365 throughout much of the Zone. One of the busiest imaging departments in Canada, we complete almost 900,000 studies in the Calgary Zone annually. Exam turnaround times are impressive, with a median time from exam completion to a finalized attending radiologist report for Emergency Department studies at our adult sites ranging from 25 minutes for ultrasound to 41 minutes for CT. Although the advantages of near real-time reporting of inpatient and emergency imaging studies are obvious, it is important to note that this exemplary and invaluable level of service is uncommon in Canada. The value that radiologists provide to patient care extends far beyond image interpretation and includes subspecialty consultation, quality improvement initiatives, appropriateness projects, multidisciplinary rounds, trainee education, CME and research. The dedication of our members to exceptional patient care is a source of pride for the entire diagnostic imaging team.

MEMBERSHIP

The Department of Radiology comprises a diverse and dynamic membership of clinical and academic faculty, graduate students, postdoctoral fellows, residents, clinical fellows, and research staff. Many academic members hold secondary departmental affiliations and are full or partial members of one or more of the seven Cumming School of Medicine research institutes. The Department is home to 146 faculty members, 41 research trainees (excluding summer students) and almost 40 radiology residents and fellows. The diversity of the department presents a unique opportunity for multidisciplinary collaboration, spanning the spectrum of basic science to clinical translation and enables a rich training environment for the next generation of scientists and clinicians.

In the development process for this strategic plan, a subgroup of faculty members was asked to provide feedback on nine cultural dimensions of the Department. Overall, the results were encouraging and highlighted the Department's commitment to an innovative environment, the strength in its people, and the value placed on excellence. The responses also illuminated areas for improvement. In particular, members felt that although collaboration is central to their work, the Department is not currently facilitating and incentivizing collaboration to its full potential. Furthermore, recognition and reward of excellence could be bolstered. These areas of improvement are directly addressed in this strategic plan and are key components to strengthening the Department and its members.

Lastly, most Department members hold multiple affiliations, including with secondary departments, Cumming School of Medicine Institutes, centres, and collaborative teams. This reality is reflective of the multidisciplinary nature of the Department but can also lead to a dilution of the time and energy of members. This strategic plan will help to clarify the role and value of the Department, establishing it as the members' 'home', serving as a foundational support for training and development, which is then enriched and complemented by association with other groups.

DEPARTMENT OF RADIOLOGY Membership at a Glance



- **41** Graduate Students and Postdoctoral Fellows
- **26** Radiology and **4** Neuroradiology Residents
- 9 Clinical Fellows
- 42 Research Staff

SECONDARY DEPARTMENT AFFILIATIONS

- Cardiac Sciences
- Cell Biology & Anatomy
- Clinical Neurosciences
- Kinesiology
- Mechanical & Manufacturing Engineering
- Medicine
- Oncology
- Paediatrics
- Physiology & Pharmacology
- Psychiatry
- Surgery

ALBERTA HEALTH SERVICES AFFILIATION

Department of Radiology Faculty



PARTNERS AND COLLABORATORS

The Department of Radiology is collaborative by nature, and its strong linkages with the University, health system, industry, and the community are critical to its success and impact. The success of this strategic plan is fully dependent on the success of partnerships, and the Department of Radiology will continue to prioritize its relationships so that all groups can achieve more, together.



Photo by Riley Brandt

UNIVERSITY OF CALGARY

The University of Calgary is guided by its *Eyes High* strategy, which was recently renewed to redefine its path toward being recognized as one of Canada's top five research universities. Central to its revitalized plan are three foundational commitments:

Sharpen Focus on Research and Scholarship Enrich the Quality and Breadth of Learning Integrate the University with the Community

The Department of Radiology sees itself as a critical contributor and catalyst within the *Eyes High* vision, and is strongly aligned with the strategic priorities of the Academic and Research Plans of the University of Calgary. In particular, the Department of Radiology will be a driving force for the University of Calgary in its efforts toward interdisciplinarity, seeding and implementing innovation, increasing the utility and accessibility of key methodologies and platforms, and paving clear pathways from discovery to translation.

CUMMING SCHOOL OF MEDICINE

The Cumming School of Medicine is guided by the University of Calgary's *Eyes High* vision and has identified its own complementary strategic priorities in three core areas: People, Platforms, and Partnerships. The Faculty recognizes its important role as a research enabler, educator, and care provider and supports innovation in these areas via seven research institutes:

- Alberta Children's Hospital Research Institute: fostering healthy biological and psychosocial trajectories for babies, children and youth through excellence in research, innovation, knowledge translation, and education.
- Arnie Charbonneau Cancer Institute: supporting research that addresses the biological and therapeutic challenge of cancer, the population and public health challenge of cancer, and the personal, family, and societal challenge of cancer.
- Hotchkiss Brain Institute: inspiring discovery and applying knowledge towards innovative solutions for neurological and mental health disorders.
- Libin Cardiovascular Institute: focusing on cardiovascular care from health promotion and disease prevention, through diagnosis and treatment, to rehabilitation and palliation in an environment that fosters the generation of new knowledge and education of new practitioners and scientists.



- McCaig Institute for Bone and Joint Health: multidisciplinary teams striving for early and accurate diagnosis, understanding of disease cause and progression, development of personalized treatments, prevention of bone and joint conditions, and improvement of health care delivery in Alberta.
- O'Brien Institute for Public Health: working to describe, design, and suggest improvements to ensure health research knowledge is translated into new models of care and changes to health policy, to benefit people across Canada.
- **Snyder Institute for Chronic Diseases:** creating and translating knowledge to improve the lives of chronic disease sufferers.

CENTRES AND PROGRAMS

Affiliated with the Cumming School of Medicine and its Institutes

- Calgary Image Processing and Analysis Centre: enhancing Calgary's capabilities in managing and coordinating large-scale, multi-centre imaging trials. Affiliated with the Seaman Family MR Research Centre, the Centre is currently managing 20 studies with data collection at >60 centres worldwide.
- Centre for Mobility and Joint Health: an imaging, motion assessment, and biomarker facility designed to support clinical research in bone and joint health.
- Child and Adolescent Imaging Research Program: developing and applying the most advanced imaging technologies, training the next generation of pediatric imaging scientists, and improving brain health for children and adolescents.
- Experimental Imaging Centre: a translational imaging program including a 9.4T small animal MRI for pre-clinical imaging, equipment for monitoring small animal physiology in the MRI, a 0.2T open MRI for musculoskeletal research and the largest range of near-infrared spectroscopy and oxygen measurement equipment dedicated to animal and brain science in Canada.
- Healthy Brain Aging Initiative: enabling highly collaborative and organized research efforts that cut across basic, clinical, and population health research pillars, and multiple disciplines, Departments, and Faculty institutes.

- MR-Guided Focused Ultrasound Program: a comprehensive research platform that develops and utilizes cutting-edge focused ultrasound technology to advance neurosurgery, drug delivery, and neuromodulation.
- Neuroimaging Research Unit: facilitating the use of key electroencephalography and functional magnetic resonance imaging resources and to ensure the highest quality brain imaging data by offering state-of-theart imaging technology, infrastructure, and technical assistance within the Seaman Family MR Research Centre.
- Seaman Family MR Research Centre: dedicated to research and development into new imaging and associated technologies, as related to diagnosis, therapy, and outcome. The Centre currently houses two 3T MR scanners, has MRcompatible electroencephalography equipment, sophisticated automated gas control systems, and image processing facilities.
- Stephenson Cardiac Imaging Centre: this Centre's vision is to become a leading academic program for the clinical implementation and validation of precision healthcare through standardized cardiac phenotyping. With units at the Foothills Medical Centre and South Health Campus, the Centre is currently one of the busiest cardiac magnetic resonance imaging programs in North America.

ALBERTA HEALTH SERVICES

The Department of Radiology is intimately linked with Diagnostic Imaging within the Calgary Zone of Alberta Health Services. The University of Calgary, Cumming School of Medicine and Alberta Health Services share a common vision and priority in precision health, and medical imaging is a critical component of making this vision a reality.

Calgary Zone acute care sites where the Department of Radiology operates include:

- Alberta Children's Hospital
- Foothills Medical Centre
- Peter Lougheed Centre
- Rockyview General Hospital
- South Health Campus

INDUSTRY

Technology is at the core of medical imaging. The Department's role in innovation is recognized by industry partners, who are significant supports of education, training, infrastructure and capacity building.

Notable industry partners include, but are not limited to:

- Calgary Scientific
- GE Healthcare
- InSightec
- Siemens Canada

COMMUNITY

The Department of Radiology is fortunate to be the recipient of significant community supports through individuals and organizations. Recognizing the significant role of medical imaging, the generosity of the community has helped to enrich and elevate the work of the Department and its members through significant investments in research, infrastructure, and education. Notable community partners include, but are not limited to:

- Alberta Children's Hospital Foundation
- Alex and Kaye Cummings
- Calgary Health Trust
- Cumming Medical Research Fund
- EFW Radiology
- Friends of Rob McAlpine
- Hotchkiss Family
- Ken Stephenson
- McCaig Family
- T. Chen Fong
- Ron and Rene Ward
- Seaman Family

OPPORTUNITIES

The Department of Radiology exists within a complex and diverse environment, extending through and across the University of Calgary, Cumming School of Medicine, multiple Departments, Institutes, and centres, the provincial health system, industry and the community. The Department is committed to integrating research, education, and clinical care through collaborative, multidisciplinary approaches and this strategic plan is intentionally designed to highlight alignment and shared priorities across partners, identifying opportunities to collaborate and move forward together. Guided by the University of Calgary's Eyes High vision and the Cumming School of Medicine's strategic plan 2015-2020, the Department of Radiology sees significant shared opportunity for building research capacity, recruiting the best and brightest people, fostering innovation, establishing an impactful and accessible platform and, ultimately, elevating the profile of the University on the national and international stage. The launch of this strategic plan in the Fall of 2018 formalizes the Department of Radiology as a ready and enthusiastic collaborator and serves as an invitation to all partners to work together to lead improvements in health through advanced medical imaging.

STRATEGIC PLAN 2018 - 2023

SUMMARY of STRATEGIC DIRECTION

In 2017, the Department of Radiology, University of Calgary, began a strategic planning process to define a collective vision that would drive its research and academic activities for the next five years. Following consultation with core academic and clinical members, trainees, senior leadership, and other key stakeholders, a strategic framework was developed that would position the Department as a leader in improved health through advanced medical imaging. The following pages outline the key steps required to achieve this vision.

VISION

To lead improvements in health through advanced medical imaging

OUR CORE VALUES

EXCELLENCE

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INNOVATION

Innovation is at the heart of imaging. The Department challenges the status quo by supporting the development of novel, cutting-edge imaging solutions to the most pressing health challenges.

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Encouraging continuous development of members, providing a world-class education and training environment and creating opportunities for knowledge exchange with the broader community.

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Advance health and knowledge locally and globally through the development and application of innovative and impactful precision medical imaging

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Connecting complementary strengths and building multidisciplinary teams to enable innovative, solutionsdriven imaging approaches in research, education, and care.

DIVERSITY

Creating an open and inclusive environment, recognizing that true success is achieved by embracing diversity in people, in thought, and in approach.

GOALS

To fulfill its mission and achieve its vision, the Department of Radiology's activities over the next five years will be driven by three primary goals:

GOAL 1

Establish the Department of Radiology as a globally recognized centre for excellence and innovation in research, education, and care in precision medical imaging.

GOAL 2

Enrich the education, training, and knowledge translation experience for faculty, staff, students, fellows, and residents to position them for success as global thought leaders and innovators.

GOAL 3

Enhance the existing partnership model with other Departments, Institutes, and industry that leverages complementary strengths and positions the Department as both a Centre of research excellence and an accessible research platform that catalyzes innovation from discovery to translation.

REACHING OUR GOALS: Strategies & Actions

GOAL 1

Establish the Department of Radiology as a globally recognized centre for excellence and innovation in research, education, and care in precision medical imaging.

The Department of Radiology is fortunate to be home to state-of-the-art medical imaging infrastructure within both academic and clinical environments. This, coupled with strong external funding support and a young, bright and energetic membership, has helped to establish the Department of Radiology as a Western Canadian centre of excellence in medical imaging. But a greater role for the Department is within reach. With a targeted strategy and strong partnerships, the Department can address some of the barriers that have prevented it from realizing its true potential for influence and competitiveness in the field. A new approach focused on investments in people. partnerships, and platforms is crucial.

Given the role medical imaging can play in precision health, the Department of Radiology is in a position to use the University of Calgary and Cumming school of Medicine's priority in this area as a springboard to global impact. The collective potential of cutting-edge technology, attracting and retaining the best and brightest minds, a sustainable model for growth, and an environment that fosters collaboration from bench to beside will enable the University of Calgary to be a stronger and more impactful contributor on the national and international stage. Through deliberate and strategic partnerships. this vision can be realized.

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To become a globally recognized centre for excellence and innovation, the Department of Radiology will work strategically to:

- Ensure the Department's infrastructure remains at the cutting edge
- Co-locate imaging infrastructure, faculty, and trainees whenever possible
- Expand research capacity in imaging approaches to understanding and improving health
- Create a collaborative environment that integrates across the spectrum from basic to pre-clinical to clinical



STRATEGY 1.1

Ensure the Department's infrastructure remains at the cutting-edge

MEDICAL DEFEMPECT

OBJECTIVE

Make strategic investments in equipment

ACTIONS

Short-Term (0-3 years):

- Replace aging animal MRI system – 9.4T
- Update existing human MRI systems – 3T
- Grow focused ultrasound platform (human and small animal)
- Plan for expansion of SCIC footprint to create a multimodality cardiac imaging research facility in conjunction with Cardiac Sciences, Libin, AHS, and other stakeholders

Mid-Term (3-5 years):

- Commit to build new precision medicine facility, including imaging (partnered project – see Strategy 1.2)
- Develop business and research plans for possible cyclotron investment

Long-Term (5-10 years):

 Invest in new MR imaging technology – Human 7T, 3T or MR PET

- # of equipment investments
- Value of equipment investments
- Generation and condition of equipment compared to industry standard
- Use of equipment (# of subjects or studies, utilization rates)
- Business and research plans developed for possible cyclotron investment
- Partnered agreement on new imaging facility
- SCIC expansion planning document and fundraising strategy

OBJECTIVE

Develop a sustainable funding model for imaging research facilities (cost recovery)

ACTIONS

- Re-invest research revenues to maintain, upgrade, and develop infrastructure across programs/ sites
- Define billable services and strategy to re-capture expenditures
- Partner where possible to generate revenue or offset costs (e.g. service contracts)
- Balance scheduling across existing infrastructure to maximize available time

METRICS

- Total research revenue
- Total operational costs
- Access and use of existing systems
- Centralized booking process to optimize infrastructure utilization

STRATEGY 1.2

Co-locate imaging infrastructure, faculty, and trainees whenever possible



OBJECTIVE

Break ground on a new precision medicine building, with a significant imaging component

ACTIONS

- Establish multi-stakeholder partnership to fund new facility (UofC/CSM, relevant institutes, AHS, foundations, etc.)
- Develop business plan for new facility with partners

METRICS

- Agreement established
- Timeline for completion
- Proposed equipment list



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STRATEGY 1.3

Expand research capacity in imaging approaches to understanding and improving health

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DFOV 71 2cm

EO % PET

OBJECTIVE

Attract top researchers and train students, residents, and fellows in priority imaging and health areas

ACTIONS

- Identify recruitment priorities for Department and Faculty
- Explore artificial intelligence/ machine learning as a development and recruitment area of focus
- Seek out possibilities for multi-institute hires in shared priority areas
- Align recruitment needs with Departmental core values

- Recruitment priorities identified
- # of new recruits
- # of multi-institute recruits
- # of new recruits focusing on AI

OBJECTIVE

Support faculty growth and development through mentorship

ACTIONS

- Define a mentorship process for the Department that leverages, rather than duplicates, existing processes
- Implement the renewed
 mentorship process
- Conduct annual review of mentorship program to evaluate uptake, utility, and impact

METRICS

- Mentorship process developed and implemented
- Outcome of mentorship annual review
- # of successful promotions of junior faculty

OBJECTIVE

Ensure all faculty are adequately supported by strong external funding

ACTIONS

- Mandate use of internal peer review mechanisms to maximize competitiveness of applications
- Regularly communicate external funding opportunities to members

METRICS

- # of applications submitted (tri-council, industry, etc.)
- # of applications successful (tri-council, industry, etc.)
- Total # and value of awards
- Success rate of applications

OBJECTIVE

Recognize and reward success of members

ACTIONS

- Establish a communications liaison (explore partnership opportunities with other departments)
- Regularly communicate faculty/trainee successes to Department members
- Introduce rewards for high performance where possible (e.g. publications in high-impact journals, success in major funding competitions)
- Connect with CSM and Institute communications to share major successes to the broader community

- Communications liaison position defined and filled
- # of communications circulated
- # of rewards created
- # of rewards awarded
- # and type of external media

STRATEGY 1.4

Create a collaborative environment that integrates across the spectrum from basic to pre-clinical to clinical

OBJECTIVE

Create mechanisms for increased interaction of clinical and research faculty members

ACTIONS

- Offer events that connect Image Science, Clinical faculty, and trainees
 - Expand existing Research Day
 - Introduce informal social events (e.g. TGIF)
 - Introduce annual 'meet and greet' event

METRICS

- # of events created
- # of event participants

OBJECTIVE

Increase visibility of members to facilitate collaborations

ACTIONS

- Trainee and Faculty bios on website
- Mechanisms to enhance internal communications (social media, newsletter)
- Host quarterly clinical/ research roundtables to identify opportunities for collaboration

METRICS

- Website and social media traffic
- # of new collaborations

OBJECTIVE

Recognize and reward collaboration

ACTIONS

- Introduce small Departmental seed grants for projects that include both clinical and basic science trainees
- Profile collaborations on website, social media, etc.

- # of scholarships created
- # of scholarships awarded
- *#* of active collaborations
- # of collaborative publications (manuscripts and abstracts)

GOAL 2

Enrich the education, training, and knowledge translation experience for faculty, staff, graduate students, fellows, and residents to position them for success as global thought leaders and innovators.

Education and research are at the core of the University of Calgary's mission, and success is measured through the accomplishments of trainees, the successes in their careers, and the impact of their discoveries on humankind. For the Department of Radiology to truly achieve its vision, it must invest in the education, training and development of its current trainees, staff, and faculty and in establishing a strategy for attracting the best and brightest minds to Calgary. By developing a trainee-centred approach, the Department can distinguish itself as a destination for value-added education, training, and knowledge translation in radiology.

The University of Calgary, the Cumming School of Medicine and its seven Institutes offer outstanding training programs and initiatives relevant to radiology trainees. The intent of the Department of Radiology's planned activities in education is not to duplicate these efforts, but rather to leverage, build-upon and enhance them to ensure radiology trainees have the best and most enriching experience possible.



To reach its educational goal, the Department of Radiology will work strategically to:

- Attract the best and brightest research trainees
- Provide a comprehensive and value-added training environment beyond traditional education
- Embrace a competency by design (CBD) approach to clinical education and expand its Royal College accredited clinical imaging fellowships

STRATEGY 2.1

Attract the best and brightest radiology trainees

OBJECTIVE

Increase recruitment of high quality trainees

ACTIONS

- Develop trainee recruitment strategy (for internal UofC and external)
- Develop assessment/ selection criteria to ensure excellence and diversity
- Connect to existing external communications channels to advertise trainee opportunities
- Connect trainees to existing training and development opportunities (e.g. grant writing, presenting, etc.)
- Align recruitment with Departmental core values

METRICS

- # of successful recruitments
- # and value of trainee awards
- time to degree completion
- # of trainee publications (manuscripts and abstracts)
- # applications to residency and clinical fellowship programs
- Annual results of Canadian Resident Matching Service (CaRMS)
- # of clinical fellows (total)
- # ministry-funded fellowship positions

OBJECTIVE

Increase external awareness of Department

ACTIONS

- Increase visibility of Department in other relevant faculties (mathematics, computer science, etc.)
- Develop material for external marketing (e.g. slides, brochure)
- Consider greater web presence (e.g. social media)

- Marketing materials created
- Marketing materials distributed
- Social media created
- Social media activity/ engagement
- Website activity/ engagement



OBJECTIVE

Offer competitive funding opportunities and other incentives to prospective trainees

ACTIONS

- Communicate internal funding opportunities to current and prospective trainees
- Work with institutes to create new imaging scholarships/awards

METRICS

- # of awards created
- # of applications received for existing and new awards
- # of awards allocated

STRATEGY 2.2

Provide a comprehensive and value-added training environment beyond traditional education

OBJECTIVE

Trainees are actively participating in the cultivation of new and innovative precision medical imaging research ideas and approaches

ACTIONS

• Ensure Department is aligned with planned University of Calgary innovation initiatives, including the Hunter Hub for Entrepreneurial Thinking

- # trainees taking part in University innovation initiatives
- Success in innovation awards/ competitions

OBJECTIVE

Trainees receive a positive training experience that expands their career horizons

ACTIONS

- Connect trainees to professional development opportunities to explore career trajectories
- Encourage trainee involvement in University of Calgary internship program for real-world experience
- Create opportunities for trainees in teaching new modules, supervising students, etc.
- Develop tools to assess trainee satisfaction
- Integrate existing databases to track and celebrate post-degree trainee success

METRICS

- *#* trainees taking part in professional development
- *#* trainees in internship positions
- Trainee teaching experience
- Trainee supervisory experience
- Trainee satisfaction
- Databases integrated

OBJECTIVE

Trainees are networked with each other, Department, faculty, and relevant partners

ACTIONS

- Incentivize trainee involvement in Departmental networking events
- Make new training modules/ workshops available to staff/trainees beyond Radiology
- Introduce Radiology trainee representative to existing trainee organizations (e.g. HBITO, PDFA)

METRICS

- *#* of trainee participants in networking events
- # of radiology trainee representatives serving on trainee organizations
- *#* of trainees participating in trainee organization events

OBJECTIVE

Trainees have access to courses and other training specific to their research areas

ACTIONS

- Review course offerings and requirements
- Introduce training modules/workshops in gap areas

- Course enrolment
- Course evaluations
- New modules created
- # of participants in new modules

STRATEGY 2.3

Support continuous development of faculty and staff



OBJECTIVE

Clinical and research faculty and departmental staff are actively engaged in their personal education and development

ACTIONS

- Encourage faculty and staff to identify development needs/priorities
 - Annual meeting of research faculty with DH
 - Clinical faculty AHS periodic reviews
- Leverage existing training (e.g. skills workshops) and professional development (e.g. project management) programs
- Connect to online resources available through the University

- # of faculty/staff participating in training programs
- % of research faculty participating in DH annual reviews
- % of faculty completing periodic reviews on-time
- # of faculty/staff participating in professional development programs
- # of faculty/staff participating in online training
- Types of courses/training taken

STRATEGY 2.4

Embrace competence by design (CBD) approach and strategic growth of Royal College accredited imaging fellowships

OBJECTIVE

Become a destination of choice for fellowship and residency training in Canada

ACTIONS

- Increase Royal College accredited fellowship programs
- Leverage areas of clinical unique expertise (EVT and CEUS)

METRICS

- Growth in Canadiantrained applications and clinical fellows
- # and percentage of Royal College-accredited clinical fellowships

OBJECTIVE

Offer Clinical facultyled CME activities that leverage academic strengths and outdoor lifestyle

ACTIONS

 CME opportunities for radiologists, trainees, and colleagues

METRICS

- # of CME events offered
- Total attendance

OBJECTIVE

Be a national leader in transition to CBD

ACTIONS

- Increased number of Clinical Faculty leaders in education
- Explore opportunity to apply CBD approach across all Departmental education

- # of education-related papers and manuscripts
- Protected time for education leaders

GOAL 3

Enhance the existing partnership model with other Departments, Institutes, and industry that leverages complementary strengths and positions the Department as both a Centre of research excellence and an accessible research platform that catalyzes innovation from discovery to translation.

Medical imaging is a field that spans the University, with applications across multiple faculties, departments, and institutes. Supported by the University's priority in cross-cutting and multidisciplinary research initiatives, the Department of Radiology has a unique opportunity to expand upon its role as a University-wide platform, enabling integration of diverse perspectives to drive excellence in research and innovation. To truly harness the potential of this platform, though, requires awareness of the opportunities across the University, knowledge of the value of medical imaging, alignment across partner priorities, and clear paths to access expertise and services. Furthermore, the Department must look beyond the University to strengthen its partnerships with the health system and industry to create a pathway for translation and implementation of research as well as a robust mechanism for continuous feedback. By formalizing its role as a platform and catalyst, the Department of Radiology is positioned to elevate the University's collective role as a leader and innovator in precision medical imaging.



To reach its goal to become an accessible partnership platform, the Department of Radiology will work strategically to:

- Capitalize on complementary strengths of key partners
- Increase accessibility to radiology as a Universitywide platform
- Create an innovation pipeline from discovery to translation and back



STRATEGY 3.1

Capitalize on complementary strengths of key partners

OBJECTIVE

Enrich and expand collaborations with key Departments, Institutes, and industries

ACTIONS

- Meet with Department Heads, Institute Directors, and corporate partners to:
 - Identify complementary strengths and shared priorities
 - Identify opportunities for collaboration and simplify process for cross/adjunct appointments
 - Help build imaging initiatives into the strategic plans of others
- Leverage existing plans for renovation/expansion of imaging infrastructure at partner sites
 - Collaborate on development of infrastructure grant proposals
 - Partner on development strategies, including fundraising

- # new collaborations
- # of key stakeholder strategies that incorporate imaging and Radiology
- Cross appointments/ adjunct appointments with other relevant departments/faculties
- # of infrastructure grants submitted
- # of infrastructure projects initiated
- # of infrastructure projects completed

STRATEGY 3.2

Increase accessibility to Radiology as a University-wide platform

OBJECTIVE

Create an environment where the Department's imaging infrastructure is recognized as an open and accessible research platform

ACTIONS

- Develop engagement options for prospective collaborators (e.g. 'packages' to support their work, including combination of study design, data collection, and/or data analysis)
- Make infrastructure access rules simple, transparent and safe
- Ensure research staff are identified and available for other groups to connect with to initiate and execute imaging research

METRICS

- Engagement options
 developed
- # of users
- Extent/type of collaborations (as related to 'packages")
- # of Departments/ Institutes using facilities
- Research productivity of collaborators (grants, publications, trainees, etc.)

OBJECTIVE

Increase university-wide awareness of collaboration opportunities

ACTIONS

- Communicate opportunities to university community
- Attend relevant university events

METRICS

- # of communications
- # of events attended
- # of new collaborations

OBJECTIVE

Participate in International Day of Radiology

ACTIONS

- Host on-campus information event/booth
 - Involve radiologists, researchers, and trainees

- # attendees
- # department volunteers involved

STRATEGY 3.3

Create an innovation pipeline from discovery to translation and back

OBJECTIVE

Expand partnerships to enable innovation pathways

ACTIONS

- Enrich existing and develop new partnerships with relevant industry
- Strengthen connections with Strategic Clinical Networks

- Partnerships established/ expanded
- # tools/approaches in or through pipeline
- Impact on practice and care









IMPLEMENTATION

The Department of Radiology's 2018-2023 strategic plan presents a unified vision for the future of medical imaging at the University of Calgary.

Developed through consultation with faculty, trainees, staff, partners, and stakeholders, this plan reflects, for the first time, the collective voice of the Department and paves a path to success.

Given the diversity and multidisciplinarity of the Department of Radiology, the strategic plan cannot address all possibilities. Instead, the intention of this plan is to define the key steps required over the next five years to elevate the work of the Department and its members and become a leader in improving health through advanced medical imaging.





To bring the strategic plan to life, there must be a commitment to action. Successful implementation of the plan will require full endorsement from Faculty and Departmental leadership and the diversity of partners and collaborators. Department members will have to take ownership of aspects of the plan to introduce it to the broader membership, drive its activity, and ensure its ongoing progress. Focused operational plans will be developed and delegated as appropriate and annual monitoring of progress toward the metrics and overall goals will be crucial. Furthermore, a midterm review will be undertaken to assess progress and reevaluate the goals and strategies.

As formal operational and implementation strategies are developed to launch the plan, the following steps will be taken in the interim to introduce the plan to the broader membership and other partners:

- Share the strategic plan with key members, partners, and stakeholders to invite feedback and support for implementation;
- Identify individuals and/or working groups to take ownership of the planned activities and develop specific operational and implementation plans, including specific actions, metrics, timelines, and accountabilities;
- Funded through research revenues, recruit and onboard a new staff member responsible for driving the execution of the plan, together with members;
- Officially launch the plan to the full Department membership in the Fall of 2018;
- Develop a plan for ongoing tracking and evaluation to ensure progress toward goals, identify barriers, and redefine strategies/ actions if required.



DEPARTMENT OF RADIOLOGY

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UNIVERSITY OF CALGARY CUMMING SCHOOL OF MEDICINE Department of Radiology