3. Disease Areas

Emerging from the very wide areas of interest within the Faculties are four major disease themes: Infection and Inflammation; Cancer; Neuroscience and Mental Health; Aging, Disability and Chronic Disease. In addition to addressing the most important health issues of the moment, McGill has specific opportunities to enhance its research performance in each of these areas.

3.1 Infection and Inflammation

The 21st century is witnessing the re-emergence of infectious diseases as a major threat to global health. This is due in part to increased prevalence of highly antibiotic-resistant microorganisms as well as the continuous appearance of new and highly virulent pathogens. Antimicrobial overuse, increased globalization, population mobility, and a changing climate all additionally contribute to the growing threat of infectious disease. At the same time, studies of inflammatory and immune responses to infection and tissue injury are providing novel insight and new therapeutic opportunities in major chronic inflammatory disorders ranging from inflammatory bowel disease, multiple sclerosis and periodontal disease to asthma, that are major sources of morbidity and healthcare costs in Canada. Most recently, we have come to better understand the complex relationship between the host and the microbial world around it. We now recognize that the microbiome found on the body’s mucosal surfaces plays a central role in the programming and regulation of the immune response, and is a major determinant of health and disease.

At McGill, the efforts in this area will build on long-established strengths and will take advantage of the presence of substantial resources in genomics, informatics and epidemiology. Specific areas of effort will be in the field of tuberculosis, chronic viral diseases (including human papilloma virus) and, in concert with McGill’s Institute of Parasitology, key parasitic infections such as *Leishmania* and malaria. Work on the microbiome will be pursued by the Innovation Centre and by the Microbiome and Disease Tolerance Centre (MDTC) in the Department of Microbiology and Immunology. Vaccine development will be focused in the Centre for Innovative Medicine at the RI-MUHC, taking advantage of new facilities at the Glen Yards campus.

We will also build on longstanding excellence in clinical and fundamental research in connective tissue diseases, inflammatory bowel disease and chronic inflammatory diseases of the airways. These efforts will bring together strengths in clinical, epidemiologic and translational research at the MUHC and JGH, with the study of fundamental mechanisms in the Complex Traits Group, and efforts in genomics and epigenetics at the Innovation Centre.
3.2 Cancer

Cancer remains a leading cause of premature death in the western world and is now a significant global challenge in the developing world. The complex nature of cancer reflects the interaction between genetics and the broad range of environmental factors including exposure to carcinogens to lifestyle choices to infectious agents that contribute to cancer development. Although new treatment modalities have improved outcomes, where the care of some cancer patients increasingly involves the management of a chronic condition over long periods of time, our ability to successfully treat cancer has yet to be fully realized. One of the greatest challenges is the recognition that cancers are highly heterogeneous and rapidly evolving. This poses challenges for effective therapeutic intervention. Improved outcomes reflect enhanced mechanistic understanding of genetic and epigenetic changes as cells move from pre-malignancy to invasive cancer. Cancer research at McGill will continue to focus on these basic mechanisms of neoplastic transformation at the genomic as well as cellular level, interaction of tumor cells with host microenvironments, dissemination and metastasis of cancer cells, response to radiation, chemotherapeutic and targeted treatments as well as mechanisms of resistance. This will be complemented by a parallel focus on developing novel marker sets for refined clinical diagnosis, and that can support improved screening programs as well as targeted and more efficacious treatments.

The McGill clinical cancer research community has and will continue to take part in clinical trials. Future success of such activities will depend on improved collaboration and cooperation among the major cancer research units, bringing together bench scientists and their clinical counterparts. This effort will be centered in the Department of Oncology, which hosts the Rossy Cancer Network (RCN). Key goals of the RCN are to harmonize not only treatment strategies but also informatics and outcomes measurement, initially across McGill teaching hospitals and eventually branching out across the McGill RUIS. In addition to enhancing our capacity to carry out outcomes research, the advent of the RCN will provide an opportunity to grow McGill’s efforts in psychosocial oncology, palliative care and related fields.

By bringing together the cancer care efforts of the new MUHC Cancer Centre, the Segal Cancer Centre at the JGH and the cancer program at St. Mary’s hospital, the RCN will provide a platform for excellence in translational research in cancer, complementing the leading edge fundamental research underway in the Goodman Cancer Research Centre, the Lady Davis Institute and the RI-MUHC. Specific areas of focus will include molecular and genomic markers for breast, colorectal and lung cancer, leukemia and familial cancers as well as metabolic programming as part of the development of approaches to personalized cancer interventions, which allow for adjustment of therapy to match the biological behavior of malignancies. The study of these novel approaches will be comprehensive, taking advantage of McGill’s strengths in health outcomes research, model systems, molecular pathology and clinical trial infrastructure. Also considered priority is the considerable strength that McGill has in the area of population health research on cancer prevention. McGill’s cancer epidemiology teams have been instrumental in bringing to the world HPV vaccination, and new molecular-based technologies for cervical cancer screening.
3.3 Neuroscience and Mental Health

Although considerable progress has been made in the management of stroke and other acute brain injuries, chronic diseases of the nervous system remain a major source of morbidity in all age groups. Central nervous disease also manifests itself as severe neurological and psychiatric disorders, which account for an enormous burden of disease. All of these disorders have limited therapeutic options, creating the need not only for better understanding of the underlying neurobiology, but for improvements in rehabilitation strategies and models of care delivery that better take into account the needs of patients and their families. To better address these needs, McGill will move toward a unified approach to chronic brain disease, bringing together psychiatry, neurology, rehabilitation science and related clinical disciplines such as nursing and family medicine.

From a biological point of view, McGill will build on our strengths in neuroscience, particularly imaging and genetics, as well as on research examining the molecular mechanisms of neural networks and neuronal signaling, and the development of disease-relevant transgenic animal models. The Montreal Neurological Institute and Hospital (collectively, the Neuro), and the Douglas Mental Health Institute will be major players in these efforts, forming a nucleus of excellence in fundamental neuroscience research, neuroimaging and bioinformatics. The Neuro will work in close collaboration with the RI-MUHC to bring together the neuroscience efforts across the MUHC, including the MGH based Centre for Research in Neuroscience. With the recruitment of new leadership, the Douglas research centre is poised to serve as a leading partner in neuroscience research related to severe mental illness, and to capitalize on the Douglas Institute’s strengths in clinical-research integration and the study of psychosocial determinants of brain disorders.

Researchers based at the Neuro and the Douglas will work closely with those at the Lady Davis Institute of the JGH, which has developed a leading program on Alzheimer’s Disease. These efforts will be complementary to active research programs in basic neurosciences and that are taking place in academic departments such as Pharmacology, Physiology, Biomedical Engineering, as well as Brain@McGill, which is an international collaborative partnership involving neuroscientists at McGill, University of Oxford, Imperial College London and the Neuroscience Center of Zurich.

There will be continued emphasis on understanding the biological and developmental determinants of disease, making use of existing strengths in neuroimaging, bioinformatics and animal models. Genomics technology will be used to better understand the interaction between genetics and environment and its impact on the development of chronic neuropsychiatric disorders. These efforts will be complemented by continuing clinical research programs in eating disorders, social and trans-cultural psychiatry, novel strategies for neurorehabilitation and recovery, as well as studies of mental health services, and policy.
As a result of important demographic changes in our population, and our continuing success in managing acute illnesses, aging and chronic diseases constitute overwhelming challenges for the coming decades. In addition, disability is not solely a consequence of aging: it can be congenital but can also be acquired at any time during the life-course, in the form of physical, cognitive or mental impairments that are accompanied by diminished health and limitation in everyday meaningful activities.

Such disabilities have important consequences not only for the affected individuals but also their families and for society at large. The complexity of managing chronic diseases and disabilities requires a multidisciplinary approach, including efforts at preventing, treating or repairing chronic conditions, and development of optimized management strategies and effective health and social policies. To address this challenge, McGill will bring together the efforts of the Schools of Nursing, Communications Sciences and Disorders and of Physical and Occupational Therapy, in partnership with the clinical departments to work towards the development and implementation of approaches that improve the quality of care offered to patients, and to optimize outcomes.

In addition, a small number of risk factors such as smoking, obesity, physical inactivity and poor nutrition, have an overwhelming impact on health status. Developing strategies to effectively modify or diminish the negative impact of these behaviors will engage all elements of the community, including not only health professionals, but also families, educators, and neighbors in participatory research and action processes. The participatory research group in Family Medicine and at the School of Nursing will co-lead this effort.

McGill has a rich history and will continue to build on research excellence in endocrine and metabolic disorders including studies of osteoporosis, bone, calcium homeostasis, diabetes and other chronic diseases of metabolism, which together contribute enormously to morbidity and disease burden in our society. In cardiovascular health, McGill will focus its efforts on fields in which it can make unique contributions including congenital heart disease, hyperlipidemia and hypertension as well as the study of risk factors and behavioral interventions aimed at prevention. Expertise in health outcomes research will be combined with McGill’s strengths in genomics to help better understand the interaction between genes and environments in these high-prevalence conditions.

McGill has a long tradition as a leading centre for pain research. With the recent awarding of a Canada Excellence Research Chair in Pain Research, the Faculties will further develop pain research as a key priority, which brings together clinicians, hospital-based researchers and basic scientists from several departments and divisions.

McGill has an excellent level 1 trauma centre based at the MGH, providing an opportunity to conduct interdisciplinary research in areas related to trauma, such as traumatic brain injury. The Faculties will build on the established successful programs in trauma, ranging from the development of novel approaches to trauma programs in developing countries to the development of novel tools. In addition, research in trauma requires an effort at improving our
ability to repair injury. This will be pursued in the form of device development in orthopedics, cardiac surgery and other areas and the development and application of stem cell therapies.

These efforts will be complemented by new initiatives, built around the CIHR’s Strategy on Patient-Oriented Research (SPOR), which is about to be extended to primary care. Led by the Departments of Family Medicine and Epidemiology, research will be extended to community-based clinical settings in an effort to improve the pertinence of research programs and its translation into the promotion of wellness and better health outcomes across the lifespan. Using an interdisciplinary approach with diverse strengths in Medicine (Internal Medicine, Family Medicine, Epidemiology, Nursing, Physical and Occupational Therapy, Psychiatry) and Dentistry, McGill will collaborate with the healthcare system to build on established excellence in participatory and health outcomes research.