



Kingston's research community works in partnership to advance discovery and translate knowledge into patient-centered care:



Founded in 1841, **Queen's University** at Kingston, Ontario is one of Canada's leading research-intensive institutions, combining quality and intensity in research with excellence in undergraduate and graduate education.
www.queensu.ca

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Research
 Institute

The **Kingston General Hospital Research Institute** (KGHRI) is dedicated to building innovative partnerships and pursuing excellence in patient-oriented research through a collaborative approach that leverages the combined strengths of all partners in translating knowledge into effective therapies, treatments and best practices.
www.kghri.ca



The **Hotel Dieu Hospital Research Institute** is a research development, enhancement, support and promotion centre, with a wide range of leading and exciting ambulatory care research activities.
www.hotel Dieu.com/research-institute

Providence Care

The **Providence Care Research Institute** is committed to supporting and fostering opportunities for teaching and research in a wide range of settings – creating, sharing and applying knowledge, and training the next generation of health care professionals.
www.providencecare.ca



PARTEQ
 innovations

PARTEQ Innovations works with researchers at Queen's University and Kingston's hospitals and the business and venture capital communities, helping to bring the benefits of scientific discovery to the public while returning proceeds to inventors and their institutions.
www.parteqinnovations.com



Kingston's health sciences research community in downtown Kingston, Ontario

Health sciences in Kingston: Novel research in a smart city

With its leafy streets, scenic waterfront and historic limestone downtown, Kingston is a well-preserved jewel of a city. But don't be fooled by its small-town feel. A compact, integrated and walkable research campus, teeming with multidisciplinary discovery opportunities, has made this smaller urban centre a

magnet for some of the world's brightest (even Nobel-winning!) research minds.

Kingston's health sciences research community, encompassing Queen's University, Kingston General Hospital, Hotel Dieu Hospital and Providence Care, comprises a distinctive discovery hub that nurtures multidisciplinary

approaches to big problems. From national and international networks to innovative boutique labs, clinician-scientists team up with colleagues in natural sciences, engineering, computing and social sciences to encourage new perspectives, to advance knowledge, and to train the next generation of clinicians and scientists.

Discovery for a Global Community

Using multidisciplinary teams to tackle difficult problems, our researchers are working to improve lives in some of the poorest regions in the world, with unique and game-changing results.



Amputees worldwide gain mobility thanks to work by the Human Mobility Research Centre on the low-cost prosthetic Niagara Foot

Maternal health:

New approaches to monitoring maternal health include the maternal health clinic at Kingston General Hospital, which treats pregnancy as a “stress test” for disease prevention. The clinic tests women for heart disease risk factors and provides resources and tools for maternal and family health. Globally, researchers are using cellphone apps to monitor pregnancy health, screen for cervical cancer and distribute blood pressure medication.

Family health in conflict zones:

By documenting and reporting on the complex, long-term, and often invisible consequences of war and natural disasters on individuals, families and communities, researchers are helping international organizations to improve the science and practice of delivering

humanitarian aid, and to mitigate the impact of trauma and its after-effects. The Canadian Institute for Military and Veteran Health Research is studying how the helpers in those conflicts – military personnel – are reintegrating into family and civilian life, with an aim to better understand how to facilitate these transitions. They are also studying the effects of post-traumatic stress disorder, and interventions for homeless veterans.

Universal access to care:

Improving global health means understanding barriers to care. For example, a recent global study co-authored at Queen’s has shown a widespread lack of access to radiotherapy for cancer that costs millions of lives and billions of dollars in lost economic growth in low- and middle-income countries. Medical physicists here are addressing that need,

partnering with a Canadian company to develop a rugged hybrid technology capable of providing modern-day radiotherapy in areas with unreliable infrastructure.

Fostering mobility:

For nearly 20 years, the Human Mobility Research Centre has helped amputees worldwide through its work on the Niagara Foot, an innovative, low-cost prosthetic foot. The centre’s biomechanical and materials analysis experts have helped to optimize the foot’s functionality and durability. At the same time, this work is helping to groom the next generation of biomedical innovators.

Community-based rehabilitation:

Drawing on clinicians, researchers, educators, persons with disabilities, and policy analysts in local and global communities, and based in Queen’s School of Rehabilitation Therapy, the International Centre for the Advancement of Community-based Rehabilitation aims to maximize community participation and citizenship of persons with disabilities. Recent projects have focused on health and education access for children and youth in Bangladesh, and family-centred work in combating the stigma of intellectual disability in the Democratic Republic of Congo.



Studies in molecular biology are changing the way we understand and treat disease

Big Data, Big Discoveries

Game-changing technology is increasingly opening new avenues of discovery, providing researchers with the ability to easily gather and study large data-sets in a myriad of formats and for a broad range of health research areas.

The Centre for Advanced Computing at Queen's University specializes in secure, advanced computing resources and support for academic and medical clients, and provides scientists in Kingston with access to several new technologies and processes for capturing and understanding big data.

Genomic sequencing for customized treatments:

The Next Generation Sequencing Lab, located at Kingston General Hospital, allows researchers to look at many different genes at once, using minuscule bits of DNA. This groundbreaking technology enables rapid analysis and interpretation, generating an exceptional amount of knowledge using very small samples. Cancer scientists are using this knowledge to better understand the genetic mechanisms of the disease, leading to improved, customized treatments, while other researchers are finding ways to use the data to create individualized treatment plans for patients with rapidly evolving illnesses.

Monitoring a potential health crisis:

Breast and prostate cancer are often headline news – but liver cancer remains a largely hidden disease, even though the death rate from liver illnesses has risen by nearly 30% over the past decade. Scientists here are studying the links between cirrhosis and liver cancer from both a clinical and population perspective by leveraging information in large patient databases, enabling them to elucidate the looming impact of this disease on our healthcare system. It's expected that the incidences of these diseases is expected to peak in 2020.

Providing evidence for treating chronic diseases:

Kingston is home of the Chair and Principal Investigator of the Canadian Primary Care Sentinel Surveillance Network, which is collecting patient information from electronic records of primary care doctors across Canada. The goal is to facilitate research into the prevalence and treatment of many common chronic diseases, to help health professionals and policy-makers make better decisions. The Network is using complex algorithms to combine data from different systems in a consistent and anonymized format, enabling the study of common chronic diseases such as diabetes, Chronic Obstructive Pulmonary Disease and depression.

Technology tells a story:

Using the Ontario Cancer Registry and parallel sequencing technology, researchers are investigating important biomarkers in cancer, and documenting changes in the incidences and treatment of this insidious disease. The registry is a computerized database that contains detailed information about all Ontario cancer patients, including diagnosis, treatment and pathology reports.

Big data enables researchers to identify the specific impact of disease on populations and our health system



Clinician scientists are using patient databases to study disease links from a clinical and population perspective

Interdisciplinary Hubs: new ideas, new approaches

Kingston is home to national and international networks of researchers who take a cross-disciplinary, patient-centered approach to discovery. Here, it's not unusual to find computer scientists and engineers working alongside oncologists and orthopedic surgeons, developing innovative materials, tools and treatments that inform best practices and improve care.

Human Mobility Research Centre (HMRC)

Offering labs within two hospitals as well as meeting rooms and even a computer-assisted surgery suite, HMRC creates unique opportunities for clinicians and scientists to collaborate. A surgeon can come out of surgery with a question, such as how to improve a procedure, and then do the research or work with a scientist who can help them develop a solution. Collaboration and cross-disciplinary teams are the norm – for example, orthopedic surgeons are leveraging the

biomechanical, imaging and computational modelling expertise of their colleagues to develop better approaches to treatment of wrist, shoulder, ankle and knee problems. Chemical engineers are working alongside surgeons to generate replacement tissue such as ligaments to treat joint injuries.

Queen's Cardio Pulmonary Unit (Q-CPU)

The international team within the Q-CPU lab includes respirologists, epidemiologists, cardiologists, hematologists and neurologists, all working together to ensure a better quality of life for patients with pulmonary arterial hypertension (PAH), the obstruction of lung arteries, which can lead to fatal right heart failure. Working in a network of six clinical trial centres across the Americas, this group will further define the basic mechanisms that underlie PAH, with an aim of identifying and testing possible treatments, and eventual translation to patient trials.

Centre for Neuroscience Studies (CNS)

The CNS has an international reputation for its cross-disciplinary neuroscience research programs, with cutting-edge facilities and a diverse team that

includes clinician-scientists, physiologists, molecular biologists, psychologists, mathematicians, physicists and computer scientists. Working across university and hospital settings, enabling novel, patient-oriented studies, CNS researchers are global leaders

in understanding sensory, motor and cognitive control of behaviour. Their work offers potential for novel and effective treatments, technologies and approaches for treating and ameliorating neurological disease and psychiatric disorders.



In-hospital exercise physiology labs enable novel research into combined heart-lung disease

Canadian Frailty Network

Canada's health system, along with those of many other countries, must be prepared to understand and manage an increasingly aging population. The multidisciplinary Canadian Frailty Network promotes evidence-based research, knowledge-sharing and clinical practices that improve healthcare outcomes for frail elderly Canadians, their families and caregivers. The network collaborates with patients, industry, academic institutions and patient-advocate partners to mobilize research and support training of highly qualified personnel to focus on the urgent care needs of this vulnerable population.

Gastrointestinal Diseases Research Unit (GIDRU)

With a multidisciplinary team of clinician-scientists from the departments of Medicine, Surgery and Pathology, and Biomedical and Molecular Sciences, GIDRU focuses on collaborative research and training opportunities to facilitate bench-to-bedside discovery. The hospital-based facility includes state-of-the-art laboratory space, as well as office and meeting areas to facilitate collaborative discovery. GIDRU teams study a wide spectrum of factors influencing gastrointestinal diseases, from pain mechanisms in irritable bowel syndrome to new treatments for *C. difficile*.

Laboratory for Percutaneous Surgery (PERK)

The PERK Lab specializes in brachytherapy, a radiation therapy technique that involves placing one or more radioactive sources next to or within a tumour. The advantage of this technique is that radiation doses to the rest of the patient are greatly reduced so that higher doses of radiation can be safely directed to the tumour. However, accurate placement of the radiation sources is key to effective treatment. To address this problem, scientists here are working to combine modern imaging techniques with 3D printing to generate custom templates that can be used to precisely and reproducibly guide the placement of the radioactive sources for a patient's treatment.



Globally recognized lab facilities provide discovery, training and commercialization opportunities

From Innovation to Application

Kingston's integrated health sciences hub supports a broad base of collaborations with industry. These partnerships are driven by a common goal of translating research into novel and effective treatments, devices and practices that benefit patients and their families.

Areas of strength include allergy, cardiovascular, musculo-skeletal and respiratory diseases, neurosciences and cancer clinical trials. Leading research is also being done in urology and hemophilia.

This research environment is ideal for national and global partnerships, offering:

- A highly collaborative, multidisciplinary environment;
- A sustained focus on the invention and integration of novel technologies and approaches;
- In-house expertise for protecting and commercializing promising research;
- Vital mentoring and training of next-generation highly qualified personnel.

Areas of industry activity include:

Cancer:

The world's first clinical trial of a new viral cancer therapy is a recent example of work being led by The Canadian Cancer Trials Group, a national cancer research cooperative based in Kingston. Its Canadian network spans more than 2100 investigators at 80 member institutions, and it has collaborated in cancer clinical trials with more than 40 countries worldwide. Housed in the Queen's Cancer Research Institute, its multidisciplinary research spans population studies of cancer, through tumor biology and clinical trials, to health services research.

Neurosciences:

Transformational work in neurosciences, using novel technologies in robotics and eye-tracking developed at Queen's, is offering new approaches to understanding and treating a broad range of disease and injury. KINARM, developed by Kingston's BKIN Technologies Ltd., is the world's first robotic

system for precisely measuring the effects of brain injury. Used at more than 60 research institutions worldwide, this patented system is now used by doctors at all three of Kingston's hospitals for exploring the neurological effects of chronic and critical illnesses, from stroke, Amyotrophic Lateral Sclerosis (ALS) and Parkinson's Disease to cardiac arrest, kidney failure, and major surgery. Eye-tracking technology is being used in conjunction with outpatient clinics at Hotel Dieu Hospital to better understand diseases such as Parkinson's, Alzheimer's, attention deficit hyperactivity disorder, bipolar disease, fetal alcohol spectrum disorder, stroke and dyslexia.

Cardiac:

Cardiologists pursuing novel work in imaging are working with industry partners to develop better methods for detecting the sources of persistent atrial fibrillation, a debilitating and difficult-to-treat disease; and to enhance clinical use of compact, handheld cardiac ultrasound devices, leading to faster diagnosis and treatment.

Mental Health:

A strong focus on mental health in Kingston's institutions includes participation in the industry-supported Canadian Biomarker Integration Network for Depression (CAN-Bind), one of the world's leading depression research networks. Two Queen's researchers are part of this 200-strong, pan-Canadian team looking at finding better ways of matching a particular treatment to a specific person.

Respiratory:

New insights into cardiac and respiratory diseases are being developed through exercise-based research that focuses on the interrelationships between heart and lung. Unique laboratory facilities and industry partnerships are helping researchers explore new approaches to diagnosing and treating the breathlessness associated with cardiorespiratory diseases such as COPD, asthma and heart disease.

Musculoskeletal:

Bone and joint research at the Human Mobility Research Centre draws on expertise across many disciplines and sectors, from computer imaging and gait analysis to tissue engineering and orthopedic surgery. Industry-academic collaborations include studies in computer-assisted surgery, engineered tissue and bone replacements, and wear-resistant materials for prostheses.

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Cancer researchers are developing new testing methods to improve prostate cancer diagnoses

Allergy:

The 140-seat Environmental Exposure Unit at Kingston General Hospital is considered the gold-standard for allergy testing in North America. This unique facility enables high-throughput testing for allergy vaccines and drug candidates.

Critical care:

Multidisciplinary investigations into patient care and practices in critical care units, led out of the Clinical Evaluation Research Unit at Kingston General Hospital, are an area of growing interest for industry. Groundbreaking work includes studies in nutrition, ventilator-associated pneumonia and end-of-life care.

Nationally networked research:

Researchers in chronic pain and gastrointestinal disease are developing novel approaches and technologies for diagnosis and treatment, often with commercial partners. Now this work is being scaled up through two multi-million-dollar Chronic Disease Network initiatives being co-led by Kingston-based investigators. The Chronic Pain Network will identify new treatments to manage and prevent chronic pain; and the IMAGINE Network will look at how gut bacteria and diet cause inflammatory bowel disease (IBD), irritable bowel syndrome (IBS) and anxiety and depression that are associated with these disorders. These national networks are funded under CIHR's Strategy for Patient-Oriented Research (SPOR) program.