

pulse

health research and innovation
at ryerson university

2012

RYERSON
UNIVERSITY

Everyone Makes a Mark

pulse

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ryerson university

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Health and well-being for all:
interdisciplinary, inclusive
and innovative



by **wendy cukier**
vice-president, research and
innovation

Research and education at Ryerson address the spectrum of Canada's health-care needs. From prevention and health promotion, through detection and diagnosis, therapy and treatment and inclusive and effective systems, Ryerson researchers are solving problems to improve the health of Canadians.

At Ryerson, our definition of health is holistic and comprehensive, including physical, psychological and social well-being. As we broaden and deepen our understanding of health, we also understand the critical importance of multi-disciplinary and cross-sectoral perspectives to address the major health concerns of our time.

Innovative approaches to health research are underway across the university and across disciplines. Researchers in Occupational and Public Health, Nursing, Midwifery, Nutrition and Food, Health Services Management, Health Services Information, Medical Physics, Psychology, Biomedical Engineering, Biomedical Science and more, are seeking solutions to real-world problems. Our research actively engages undergraduate and graduate students. Health education and research at Ryerson will continue to flourish in a new applied health sciences building planned for the future.

We view health as a part of everyday living, an essential dimension of the quality of our lives. Quality of life in this context implies the opportunity to make choices and to gain satisfaction from living. Health is thus envisaged as a resource which gives people the ability to manage and even to change their surroundings. Responding to diverse needs and promoting inclusivity are critical to well-being.

A handwritten signature in black ink, reading "Wendy Cukier".

prevention

promoting healthy behaviours and sound public policies

Understanding the social determinants of health and the factors affecting well-being is the foundation of an evidence-based approach to preventing disease, illness and injury. Health promotion is expansive and has come to include creating supportive environments, promoting healthy behaviours and encouraging healthy public policies. The promotion of health affects the many stages of life such as reproductive and child health, youth and teens, adults and seniors. Effective initiatives occur in many settings such as workplaces, schools, clinics and community, and involve partnering and building capacity across multiple sectors and diverse organizations. Researchers such as **Elizabeth McCay** aim to improve the health of at-risk youth, while **Trevor Hart** leads the struggle to prevent further HIV infections in Canada. **Fiona Yeudall** assesses access to food and nutritional security of vulnerable groups while examining the role of sustainable livelihoods on food and nutrition security interventions. And **Sepali Guruge** explores immigrant women's health, in general, and violence against women throughout the migration process in the **Centre for Global Health and Health Equity**.

urban health supporting youth on the street

elizabeth mcCay
daphne cockwell school
of nursing

Vulnerable or at-risk individuals and groups are disproportionately located in urban settings, where they frequently experience marginalization, alienation and stigmatization. These factors are associated with dramatic health inequities.

Elizabeth McCay, Ryerson's inaugural Research Chair in Urban Health, focuses on the health and well-being of these populations. In particular, she addresses the emotional and psychological consequences of challenging life experiences, particularly for vulnerable youth, and the development and evaluation of strengths-based interventions to promote healthy self-concepts, resilience and adaptive capacity.

"The overall aim of my Urban Health Research Program is to address the health needs and help to improve the lives of vulnerable youth and other at-risk individuals who reside in urban areas," says McCay. "By conducting high-quality, innovative research, I strive to inform practice, education and policy."

Currently, McCay is the principal investigator on a national intervention study funded by the Canadian Institutes of Health Research and the Mental Health Commission of Canada. "The goal of this three-year project," McCay explains, "is to implement and evaluate dialectical behaviour therapy (DBT), a psychologically based intervention ideally suited to strengthen resilience in street-involved youth." Located in Calgary,



■ Elizabeth McCay's urban health research informs practice, education and policy.

Toronto and Halifax, the study's three project sites are transitional housing programs and group residences for street-involved youth.

In addition, McCay is principal investigator on an international study, recently funded by the Canadian Institutes of Health Research about an intervention based on resilience and motivational interviewing to engage street-involved youth who are beginning their journey to end their homelessness. Together these studies will support youth to successfully exit from street life.

An essential element of McCay's research is the formation of strategic and collaborative partnerships. Her DBT project, for instance, has brought together a team of co-investigators and community partners from across Canada, including universities (Ryerson, Calgary and Dalhousie); the Centre for Addiction and Mental Health; St. Michael's Hospital; Wood's Homes (Calgary), Covenant House (Toronto) and Laing House (Halifax).

HIV prevention reducing risk and promoting sexual health



■ Trevor Hart identifies critical need for research into HIV epidemic.

Trevor A. Hart
Department of Psychology

HIV/AIDS constitutes a public health crisis at home and abroad. Around the world, about 33.3 million people are living with HIV/AIDS. In 2008, there were 65,000 Canadians infected with HIV, a 14 per cent increase from 2005.

Currently supported by a five-year Career Scientist Award from the Ontario HIV Treatment Network, Trevor Hart is a leader in Canada in the struggle to prevent further HIV infections. "Given the increasing numbers of new cases of HIV in Canada," says Hart, "there is a critical need for research that helps us to understand the HIV epidemic and to fight the spread of HIV."

Carrying out his investigations in Ryerson's unique HIV Prevention Lab, Hart focuses his research on three intersecting concerns:

- Risk factors for sexual risk behaviours among adolescents and adults who are at high risk for contracting or transmitting HIV.
- Relationships between physical health and psychological outcomes among people living with HIV.
- Counselling and other interventions that promote sexual health and life expectancy and reduce HIV and other sexual-risk outcomes.

One of Hart's three current projects (all of which are funded by the Canadian Institutes of Health Research [CIHR]), is the Gay Positive Sex (GPS) Study. This community-based study examines the effects of a sexual health promotion program for HIV-positive gay and bisexual men. "Our preliminary data show that GPS may lead to a 40 per cent reduction in sexual risk behaviours," Hart notes. "In addition, there has been a great deal of positive feedback from participants underscoring how GPS has fundamentally helped them to rethink their attitudes towards safe sex and relationships in order to promote a healthy and positive sexuality."

centre for global health and health equity

sepali guruge (director)
mandana vahabi (co-director)

Inequalities relating to health comprise one of the fundamental challenges facing health-care planners and providers. The fact is, no country on earth has fully succeeded in guaranteeing universal health care for all its citizens. Variables such as socioeconomic status, gender, race, language and sexuality all too often – even in Canada – mean peoples’ health status and access to health care frequently differ significantly.

Informed by principles of equity, social justice and health as a human right, the mission of Ryerson’s multidisciplinary Centre for Global Health and Health Equity is to promote greater health equity locally, nationally and globally. Led by Sepali Guruge of the Daphne Cockwell School of Nursing, the centre’s members carry out research and social development projects on a wide spectrum of topics, including:

- Refugees’ and immigrants’ health (e.g., resilience among refugee youth).
- Women’s health (e.g., violence against women).
- Men’s health (e.g., masculinities and health behaviour, prostate cancer).
- Children’s health (e.g., commercial sexual exploitation of children).
- Health promotion (e.g., food security, health literacy).
- Mental health (e.g., policy development).
- Older adults’ health (e.g., abuse in institutional care settings).

Project funding comes from several organizations, including the Canadian Institutes of Health Research, the Canadian International Development Agency and the International Development Research Centre. Centre members currently collaborate with individuals and groups on five continents; for example, in the United States, Honduras, El Salvador, France, England, Brazil, India, Sri Lanka, China, Iran, Ethiopia and South Africa.

www.ryerson.ca/globalhealth



worrisome times understanding and overcoming anxiety disorders

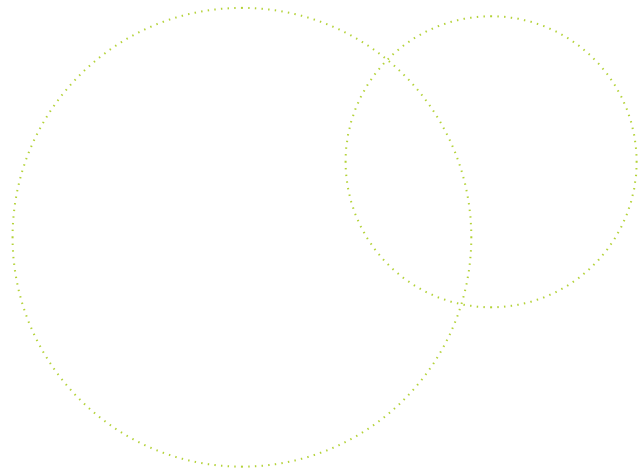
Martin M. Antony
Department of Psychology

Anxiety disorders affect about one in every four Canadians, making them the most prevalent of mental health problems. Phobias, panic disorder, social anxiety disorder, obsessive-compulsive disorder, and related conditions exact a huge toll on individuals and their families, and they place tremendous burdens on the health-care system.

Past-president of the Canadian Psychological Association, Martin Antony is a world leader in developing a greater understanding of anxiety disorders and their treatment. His internationally recognized and widely published research has been foundational in the development of therapeutic approaches to combating anxiety. Recently, for example, Antony has worked closely with colleagues in Canada and abroad to identify the relationship between anxiety disorders and various emotional, personality and behavioural factors, including anger, reduced emotional intelligence, impulsivity, smoking and a history of childhood teasing.

“I am also deeply committed to sharing knowledge about anxiety and coping beyond the scholarly and clinical domains,” says Antony, who is also chair of the Department of Psychology. His books – including the award-winning *When Perfect Isn’t Good Enough* and *Shyness and Social Anxiety Workbook* – translate evidence-based treatments into language that people seeking to overcome their anxiety and related problems can directly use.

Currently, Antony and co-investigators at York University and the University of Massachusetts are in the early stages of a project designed to tackle a serious challenge in the treatment of severe anxiety and chronic worry: non-response or partial response. “This problem,” says Antony, “can arise, in part, from low patient motivation for adhering to treatment procedures. Our goal is to test the efficacy of motivational interviewing (MI) for augmenting treatment response.” Antony and his team plan to add MI before and during cognitive behavioural therapy for excessive worry. “If our hypotheses are proven correct, our findings will have significant public health implications.”



■ Martin Antony tackles a serious challenge in the treatment of severe anxiety and chronic worry.



under the sun shielding outdoor workers from skin cancer

Thomas Tenkate
school of occupational
and public health



Solar radiation carries one of the highest health risks of any form of environmental exposure. Especially at risk are outdoor workers because many are exposed for long periods to ultraviolet (UV) rays. In addition to the serious personal health consequences, melanoma and non-melanoma skin cancers place a substantial burden on the health system both in terms of capacity and cost.

“Despite the fact that we know a great deal about the health effects of excessive UV exposure,” says Thomas Tenkate, the director of Ryerson’s School of Occupational and Public Health, “we still have a lot to learn about how much UV various categories of workers are exposed to and how to protect them.”

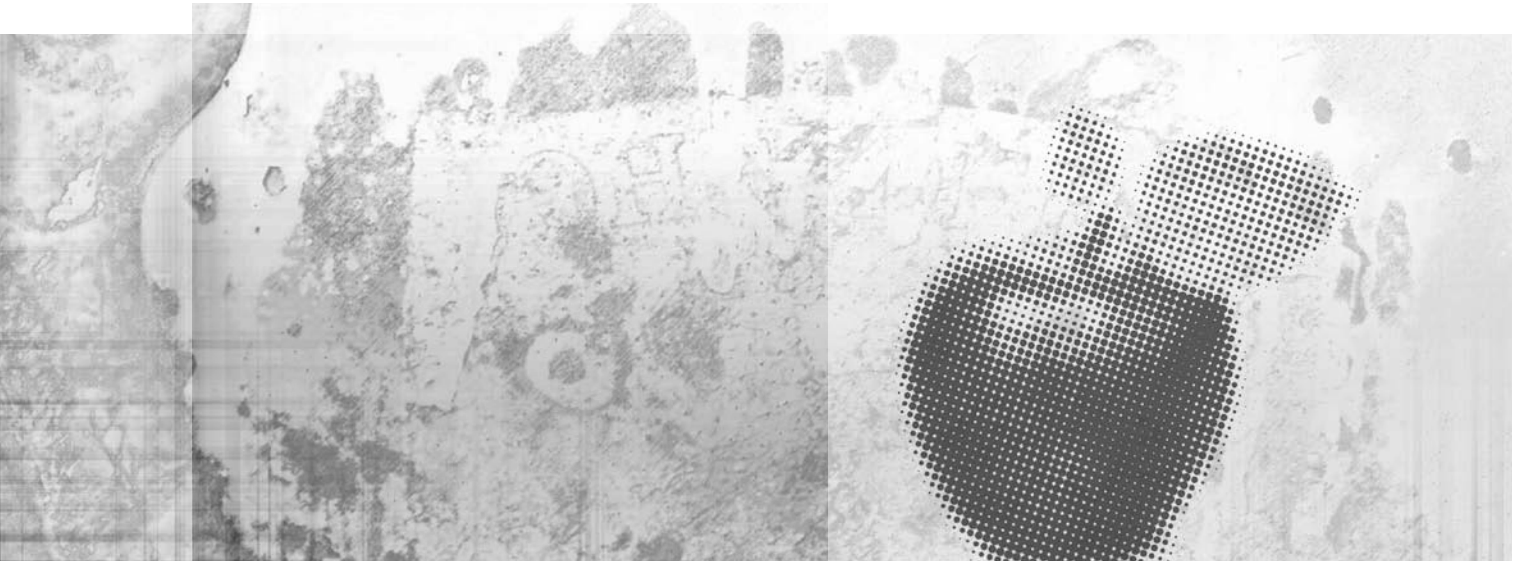
Tenkate has devoted much of his career to assessing and managing the health risks associated with exposure to solar and artificial UV radiation. Currently, he is working with colleagues in Australia to help small- and medium-sized enterprises implement effective protection measures for their outdoor workers. “Our project involves customizing and assessing the effectiveness of a suite of protection measures for individual workplaces,” he says. Two key objectives of this research, which is funded by Queensland Health, are to determine which approaches help workers to adopt sun-safe practices and which are the most cost-effective to implement.

“My current research is enriched by my years of experience in a wide variety of management, policy and advisory roles related to environmental health,” Tenkate says. This includes 10 years with the Queensland Department of Health, and responsibility for managing several local, state and national environmental-health projects in Australia.

From 2009 to 2011, Tenkate was the president of Environmental Health Australia. Widely published in national and international journals, Tenkate has edited two publications on sustainability and climate change. He has also served on the editorial committees and advisory boards of a number of leading journals, including Environmental Health.

■ Thomas Tenkate’s research assesses sun-protection practices for outdoor workers.

food for all local agriculture, healthy communities



fiona yeudall
school of nutrition

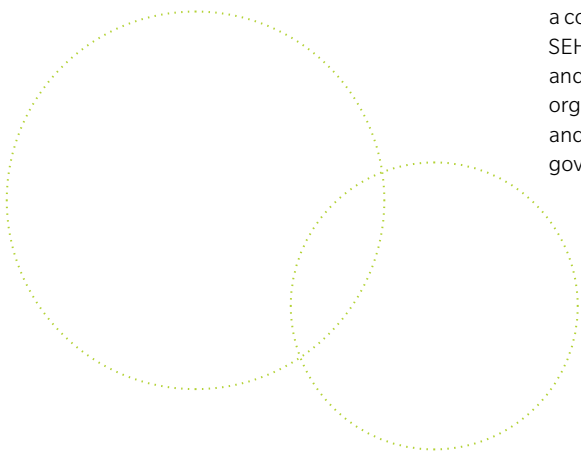
“Food brings people together,” says Fiona Yeudall. “It builds communities.”

A professor in the School of Nutrition and director of Ryerson’s Centre for Studies in Food Security (CSFS), Yeudall is an international expert researching the role urban agriculture can play in supporting individual and community health, well-being and development.

Yeudall recently completed a collaborative project, funded by the Canadian International Development Agency, that assessed an urban agricultural system for households affected by HIV-AIDS. The initiative, Sustainable Environments and Health through Urban Agriculture (SEHTUA), was based in Kenya, a country hit hard by the HIV-AIDS pandemic. SEHTUA involved community organizations and leaders, self-help groups, international organizations, university researchers and officials from all levels of the Kenyan government.

“Working in a context in which 75 per cent of project participants lacked consistent access to healthy food, we set out to facilitate a resilient and sustainable system of urban agriculture. Our ultimate goal was to help people build stronger social networks, better incomes and more consistent access to food and thus health.” While SEHTUA encountered some major challenges (including livestock deaths and disruption associated with post-election violence), participating households reported increased access to agricultural land, livestock, technical support services, banking and health facilities and social clubs.

Today, Yeudall is part of a province-wide team – funded by the Social Sciences and Humanities Research Council of Canada and the Ontario Ministry of Agriculture, Food and Rural Affairs – studying local food networks across Ontario. She is directing research documenting the contribution of Foodshare, a leading Toronto-based non-profit to improving access to affordable and healthy food – from field to table. As a long-term leader in the food movement, Foodshare sees the value of documenting and communicating its innovative work by working with researchers to translate their knowledge into practice.



detection and diagnostics

screening for diseases and detecting illness is critical to promoting health

Ryerson is a global leader in medical physics and biomedical engineering.

Researcher **Sri Krishnan** studies the body's physiological signals to determine the severity of illnesses such as pneumonia or asthma.

Ana Pejović-Milić is developing non-invasive techniques for medical applications and **Victor Yang's** research not only advances detection but finetunes the targeting of therapies to minimize side effects.



body electric detecting and analyzing physiological signals

sri krishnan
department of electrical
and computer engineering

Our bodies emit sounds that are powerful clues to the state of our health. Damaged knee cartilage, for example, clicks in certain ways that indicate the extent of tearing or disintegration. Listening closely to a patient's lungs can reveal the severity of bronchitis, pneumonia or asthma.

As the Canada Research Chair in Biomedical Signal Analysis, Sridhar (Sri) Krishnan devotes himself to tuning in to the body's physiological signals. The heart, for instance, generates complex electrical signals. Accurately detecting and analyzing them, Krishnan believes, can give physicians data useful for making informed medical decisions and, thereby, reduce sudden cardiac deaths.

Funded by the Canada Research Chairs program and the Natural Sciences and Engineering Research Council, one of Krishnan's main projects involves the development of an electronic stethoscope. "Body sounds are typically very low frequency," Krishnan notes. "An electronic stethoscope will enable us to detect these signals, store them digitally, and then analyze them in a graphical wave form."

Working with an electrical engineering graduate student and a post-doctoral fellow, Krishnan has completed the new device's algorithm. He and his team are now looking forward to conducting real-world, real-time field trials.

"One of the great advantages of the electronic stethoscope will be the reproducibility of the sounds. That means, for instance, data about a patient's respiratory system will be able to be shared among several health-care practitioners as many times as is necessary in order to arrive at the best diagnosis and treatment plan."

Krishnan also sees enormous potential for ongoing patient monitoring and clinician training. "And just think of the role this technology will play in the field of telemedicine here in Canada as well as throughout the developing world."

■ Sri Krishnan's electronic stethoscope will improve diagnosis and treatment.



Toxic measures designing non-invasive diagnostic tools

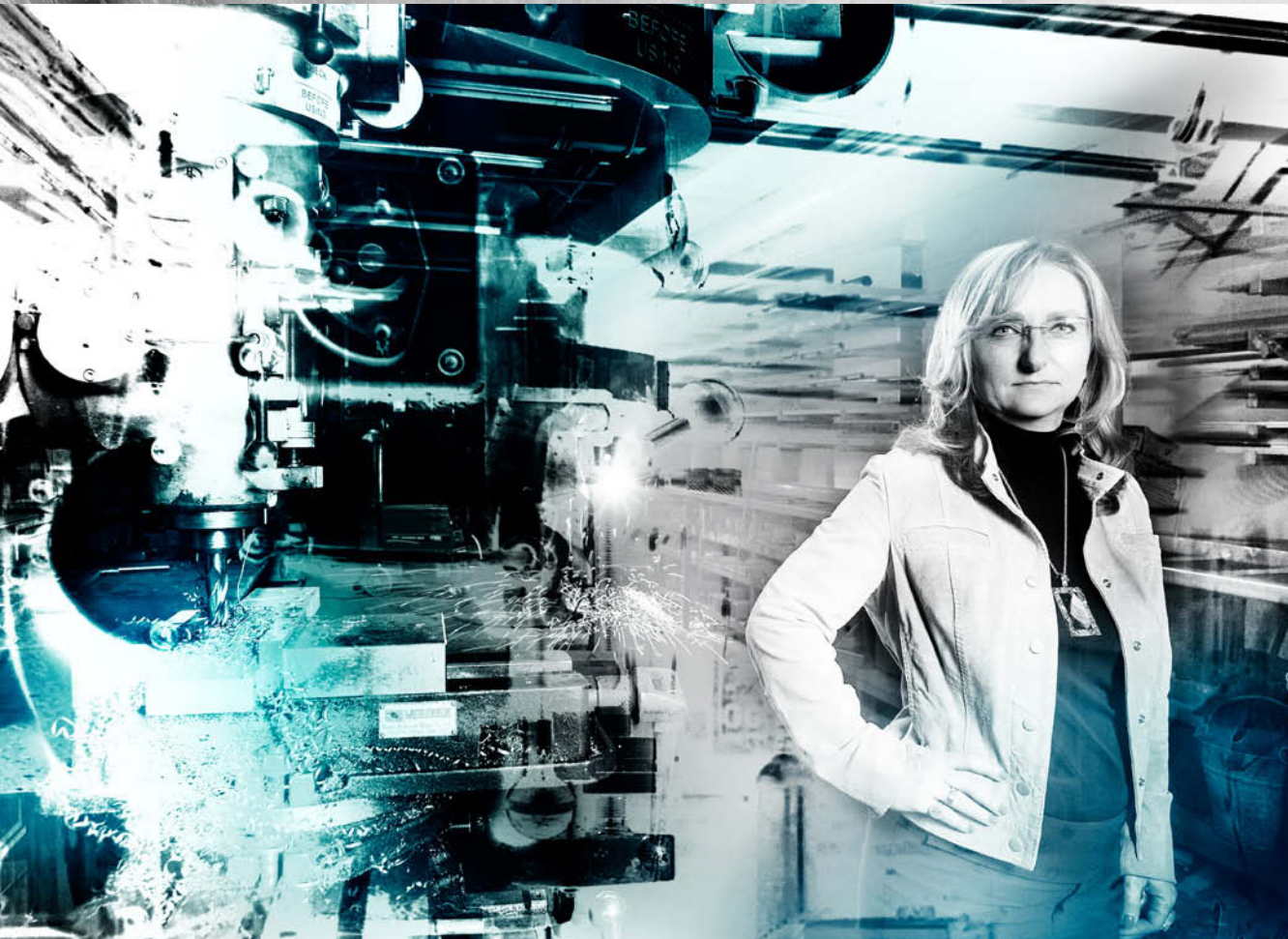
ana pejović-milić
department of physics

Measuring toxic elements in the human body is usually carried out via urine, blood and serum analysis or bone biopsy. Information drawn from blood and serum, however, reveals only recent – not long-term – exposure. Bone biopsies, meanwhile, are painful, pose risks for patients and can be performed only a limited number of times.

Working in the field of medical physics, Ana Pejović-Milić is at the forefront of developing non-invasive diagnostic techniques for medical applications. Her elemental-analysis research uses neutron activation, X-ray fluorescence (XRF) and other nuclear techniques to determine the amount of toxic trace elements stored in calcified tissues. “Our guiding principles,” she says, “are that the techniques we design should be non-invasive, painless and suitable for ongoing monitoring.”

One of Pejović-Milić’s most promising avenues of inquiry involves the development of a novel diagnostic tool – in vivo bone strontium XRF – to measure levels of strontium stored in bone. “Our main concern,” notes Pejović-Milić, “is with the correlation – positive and negative – between strontium and osteoporosis. In vivo XRF has the potential to expand our understanding of the mechanism by which strontium has either detrimental or therapeutic effects in the treatment of osteoporosis.” At the same time, Pejović-Milić is leading the development, with colleagues at McMaster, of a unique in vivo diagnostic tool to measure aluminum and manganese in bone (the latter has been associated with significant neurological disorders).

In her ex vivo investigations, Pejović-Milić’s research team is about to publish the groundbreaking results of a recent autism-related pilot study. “Our analysis of deciduous teeth revealed deficiencies in certain essential elements among autistic children compared with their siblings. We have shown that the zinc, copper, iron and nickel levels in the teeth of children who were born to a family with a child diagnosed with autism decrease according to the order in which those children were born to the same mother.” This finding challenges the hypothesis that autism is potentially associated with exposure to toxins and, as Pejović-Milić observes, “underscores the need for far more research.”



■ Ana Pejović-Milić says new autism finding underscores the need for more research.

Lighting the dark developing medical technology to detect and treat disease

victor yang
department of electrical
and computer engineering

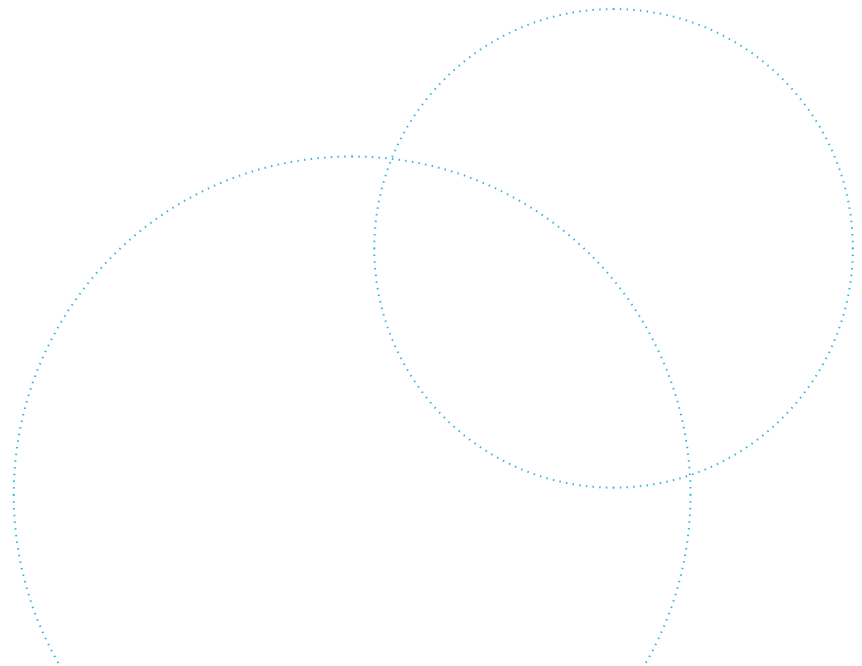
The deepest, tiniest recesses and corridors of the human body hold clues that are vital to solving some of the most complex medical mysteries. Trained as both surgeon and scientist, Victor Yang is on a quest to look more deeply and precisely into the body in an effort to reduce rates of morbidity and mortality associated with diseases such as cancer, ischemic stroke and spine disorders.

Many people are likely familiar with optical fibres for telecommunications purposes. Optical coherence tomography (OCT) – the focal technology for Yang’s work – is a novel redeployment of those fibres. Light waves produce more detailed pictures than magnetic resonance imaging and ultrasound, and do not involve harmful X-ray radiation. The challenge is how to shine the light into the human body.

“My team and I are striving to optimize OCT for medical applications,” says Yang, Ryerson’s Canada Research Chair for Bioengineering and Biophotonics. Specifically, Yang is exploring the development of tools for minimally invasive surgical procedures and techniques for generating precise, 3-D images of the body’s interior.

With colleagues at St. Michael’s Hospital, Sunnybrook Health Sciences Centre, the University of Toronto and the University of British Columbia, Yang and his team are investigating a method to navigate fibre-optic probes through arteries of the brain and heart. This new technology holds significant potential for the treatment of vascular diseases such as blocked arteries, which can cause strokes and heart attacks.

One of Yang’s current research projects involves using Doppler OCT to image the blood vessels associated with cancer. “Using light waves to detect and create images of the vasculature that feeds tumours will be a great benefit to oncologists and their patients,” Yang says. “The technology we are developing will show precisely how these blood vessels appear before, during and after treatment.”





■ An engineer and doctor, Victor Yang develops new techniques to image the human body and devises novel tools for minimally invasive procedures.

Therapy and treatments

researchers take innovative approaches to treat disease

Elizabeth McCay and **Heather Beanlands** are developing novel interventions to support self-management and promote psychosocial well-being for people living with a variety of chronic conditions.

Souraya Sidani's research focuses on building knowledge about patient preferences for treatment. **Colleen Carney** is tackling chronic sleeping disorders by investigating the efficacy of cognitive behaviour therapy (CBT). **Catherine Beauchemin** builds models to fight infectious diseases. **Habiba Bourgherara's** work improves the function of implants. **Raffi Karshafian** and **Michael C. Kolios** combat cancer with ultrasound and **Jahan Tavakkoli** also uses ultrasound for clinical applications.

Russell Viirre is searching for an effective treatment for cystic fibrosis by designing new molecules.

self-help

How patient preferences improve therapies

souraya sidani
daphne cockwell school
of nursing

■ Souraya Sidani's research sheds light on the role patient preference for treatment has on satisfaction, compliance and success.

Health-care practitioners select from among a large number of clinical and behavioural interventions to treat diseases and improve patients' well-being. Despite the wealth of effective treatment options that practitioners can choose from, patients' attitudes towards the interventions influence their decision to apply the interventions successfully.

Souraya Sidani, the Canada Research Chair in Health Interventions: Design and Evaluation, is engaged in three studies aimed at supporting the development of health interventions that are theoretically based and acceptable to patients. Supported by a grant from the Canadian Institutes of

Health Research (CIHR), Sidani is expanding knowledge of the factors that people with insomnia consider when choosing amongst treatment options. "We need to understand much more about patients' preferences," says Sidani. "By sharing that information with health-care professionals, we will be able to help them better support their patients' decision-making."

Difficulty sleeping and stress have been shown to increase the risk of heart disease. Sidani's second project, also funded by CIHR, examines the relative effectiveness of two behavioural treatments – stimulus control instructions and sleep efficiency – in improving sleep and reducing stress and the risk of heart disease. Sidani also hopes to shed light on the role patient preference for a particular treatment has on satisfaction and compliance with treatments and on improving sleep and reducing stress.

While many smokers want to kick the habit, experts still do not fully understand the role treatment preference plays in the success of their efforts. With a grant from the Canadian Lung Association, Sidani is investigating smokers' preferences for nicotine gum and counselling. More thoroughly understanding this issue will, Sidani believes, direct efforts to make these treatments widely available and facilitate the re-design of treatments. "Smokers who get the treatment of their choice will be most successful in quitting."



The balm of sleep putting insomnia and depression to rest

colleen e. carney
department of psychology

Preventing recurrent episodes of depression is crucial to the quality of Canadians' lives and to saving scarce health-care dollars. When insomnia is left untreated in people who suffer from depression, they are at significant risk for depression's return. Directed by Colleen Carney, Ryerson's Sleep and Depression Laboratory is on a mission to provide brief, effective treatment for insomnia, particularly in association with depression and other health conditions.

"Research has shown that when people complain to their treatment-providers of insomnia, many are told – incorrectly – that they have depression," Carney says. "When they actually do have depression and insomnia, patients are counselled that the insomnia will 'go away' once their depression remits. Numerous studies, however, contradict this claim: many post-depression people continue to suffer from insomnia."

Carney and her colleagues in the Sleep and Depression Laboratory are currently investigating the efficacy of cognitive behaviour therapy (CBT) for treating insomnia. CBT is a brief, inexpensive treatment recommended as the frontline treatment of choice by the National Institutes of Health (in the United States) and the British Association for Psychopharmacology. "Most provocatively," notes Carney, "studies have suggested that when CBT is used to treat the insomnia of people with depression and insomnia, many people recover from their depression and regain the ability to sleep."

In order to test this finding, Carney and her team are conducting a trial – funded by the National Institute of Mental Health – designed to identify the optimal treatment combinations for people with insomnia and depression. "Our study's discoveries will help care providers to triage people with depression and insomnia to the treatment that would produce the most efficient and effective results."

Simultaneously, financial support from Ontario's Ministry of Economic Development and Innovation and Ryerson is enabling Carney to train a minimum of nine doctoral-level CBT-for-insomnia therapists who will be prepared to deliver this treatment across the province.



■ Colleen Carney investigates how cognitive behavioural therapy helps people recover from depression and insomnia.

centre for health in at-risk populations (CHIRP)

elizabeth mccay (co-director)
heather beanlands (co-director)

The term “at-risk” encompasses a broad range of physical- and mental-health challenges. People or groups that are at risk often have a low sense of well-being and find it difficult to manage the usual activities of everyday life and the health issues that confront them.

Ryerson’s Centre for Health in At-Risk Populations (CHIRP) is committed to research and knowledge dissemination that improves the lives of individuals living with physical- and/or mental-health challenges. Led by Elizabeth McCay and Heather Beanlands of the Daphne Cockwell School of Nursing, CHIRP’s members carry out research across four fields:

- Youth at Risk – for example, studies with street-involved youth and young adults experiencing a first episode of schizophrenia.
- Self-Management – for example, issues of self care for people living with chronic illnesses.
- Psychosocial Responses – for example, enhancing coping skills to promote resilience, self-efficacy and active coping among at-risk groups.
- Action to Practice – for example, studies of program feasibility, acceptability and clinical effectiveness in real-world settings.

The centre objectives include cultivating a network of investigators to address fundamental health-related research questions, examining conceptual and methodological issues related to psychosocial interventions, creating venues for information exchange, and working toward health policy that supports the inclusion of interventions that enhance the well-being and quality of life for at-risk populations.

For more information:
www.ryerson.ca/atriskpopulations



mapping the flu mathematical models help combat viruses

catherine beauchemin
department of physics

Influenza is a major health concern for Canadians and people around the world. For example, each year between 4,000 and 8,000 Canadians die from flu-related pneumonia. One of the primary challenges involved in combating flu is the rapidity with which viruses mutate and, thereby, develop resistance to antiviral medications.

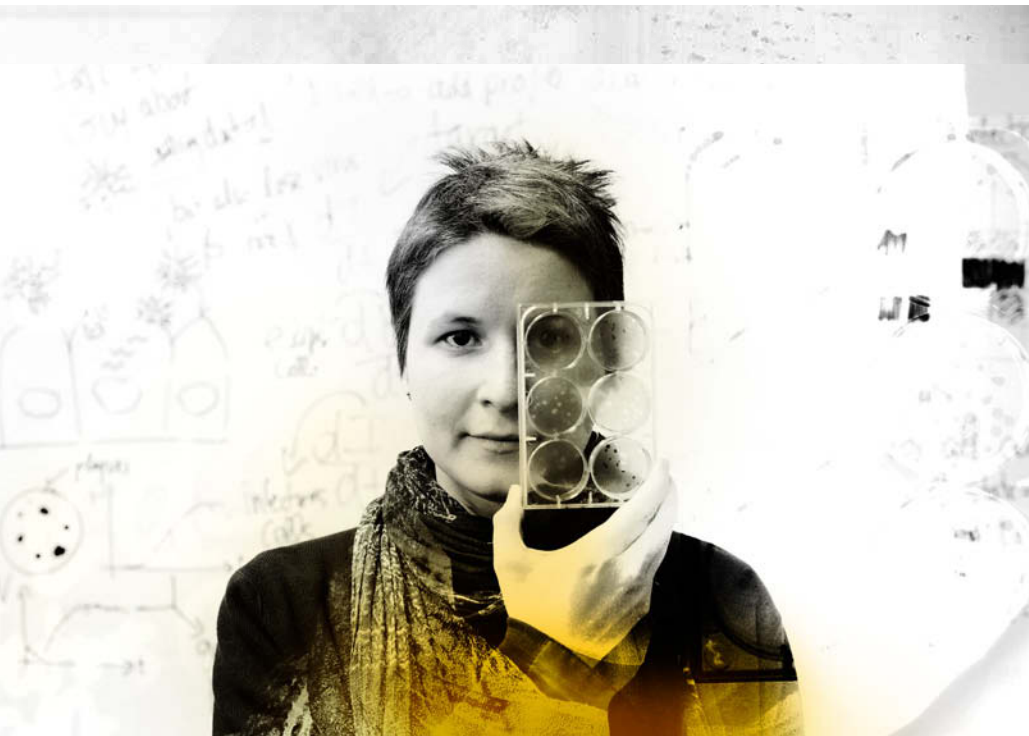
Rather than growing live viruses and testing drugs on them, Catherine Beauchemin designs mathematical and computer models in order to simulate flu infections. This approach has expanded researchers' understanding of the impact of several antiviral drugs on various flu strains, and generated knowledge of how small genetic variances among flu strains lead to differences in infection severity and outcome.

Beauchemin, whose work is supported by grants from the Canadian Institutes for Health Research, the Natural Sciences and Engineering Research Council and a number of pharmaceutical companies, describes viral infections as "a complicated ballet involving many dancers: the cells that get infected, the immune cells that show up at the site of infection and start a fight and the many chemical signals those cells secrete to communicate with and influence each other." By using a simulator, Beauchemin and her team can see and control all aspects of that complex dance.

To make sure she can trust her models' predictions, Beauchemin validates them. For this critical step, she works closely with microbiologists and virologists who provide data that the models must precisely emulate.

During the testing stage, Beauchemin and her colleagues monitor virus concentrations and observe how different antiviral drugs given at various times alter the course of infection in virtual patients. "Computerized simulation enables us to test any antiviral combination imaginable," says Beauchemin. Their mathematical models allow them to simulate experiments – for example, infecting patients with lethal doses of viruses and withholding treatment – without putting lives at risk.

■ Catherine Beauchemin's mathematical and computer models provide clues to fighting the flu.



green implants

designing new joint replacements with sustainable materials



Habiba Bourgherara mechanical and industrial engineering

■ Habiba Bourgherara is developing stronger, longer-lasting medical implants made from sustainable materials such as sheep's wool and bacteria.

About 10 per cent of Canadians have osteoarthritis, the common form of arthritis. Many of them will undergo joint-replacement surgery, receiving medical implants made from metal, including titanium.

Habiba Bourgherara is breaking new ground with a green joint-replacement design that will have a longer lifespan, reduce the number of repeat surgeries, cut health-care costs and leave behind a smaller environmental footprint than other joint replacement options currently available. A 2011 recipient of a \$140,000 Early Research Award from the Province of Ontario, Bourgherara and her team are among the first in Canada to explore green materials for medical applications.

"We are developing stronger, longer-lasting medical implants that are made with sustainable materials," says Bourgherara. "As a result, we will also expand the knowledge base of orthopedic surgeons, who will need to learn how to work with these new materials."

Bourgherara is investigating sheep's wool with the help of research partners namely, Redouane Zitoun and Lotfi Toubal at Clement Ader Institute, Toulouse University in France and University of Québec, Trois-Rivières. She's also studying the use of bacteria in collaboration with Yaser Dahman of Ryerson's Department of Chemical Engineering. Each material – after undergoing sophisticated processing – will yield medical implants that function like real human bone. As a result, they are more likely to be seamlessly integrated into the body. In addition, green materials are softer than other implants and allow the bone to carry more load.

Taken together, the benefits of green medical implants will add up to significant savings for the health-care system. Longer-lasting and better-performing implants will mean fewer surgeries. Moreover, recyclable materials will mean more implants will eventually be reprocessed and reused.

powerful bubbles targeting cancer with ultrasound

Raffi Karshafian
Department of Physics

Michael C. Kolios
Department of Physics

Morbidity and mortality rates associated with many types of cancer continue to rise. Treating this highly complex disease is a major challenge, largely because success depends on killing all the cells within a cancer that are capable of regenerating it.

When possible, the standard clinical approach to dealing with solid tumours is surgical excision, coupled with radiation therapy and/or anti-cancer drugs (e.g., chemotherapy). These treatments, however, are limited by the associated – often severe – side effects on normal tissues and non-cancerous cells.

Raffi Karshafian and Michael Kolios are members of a research team funded by the Terry Fox Foundation that is attempting to address these concerns through the development of a microbubble-based ultrasound system.

“Microbubbles are comprised of tiny bubbles that are smaller than red blood cells,” Karshafian explains. “They are currently used in cancer detection. Our efforts, meanwhile, focus on deploying ultrasonically stimulated microbubbles in order to sensitize tumours to radiation and to improve the delivery of chemotherapeutic agents and gold nano-particles selectively to tumour tissues.”

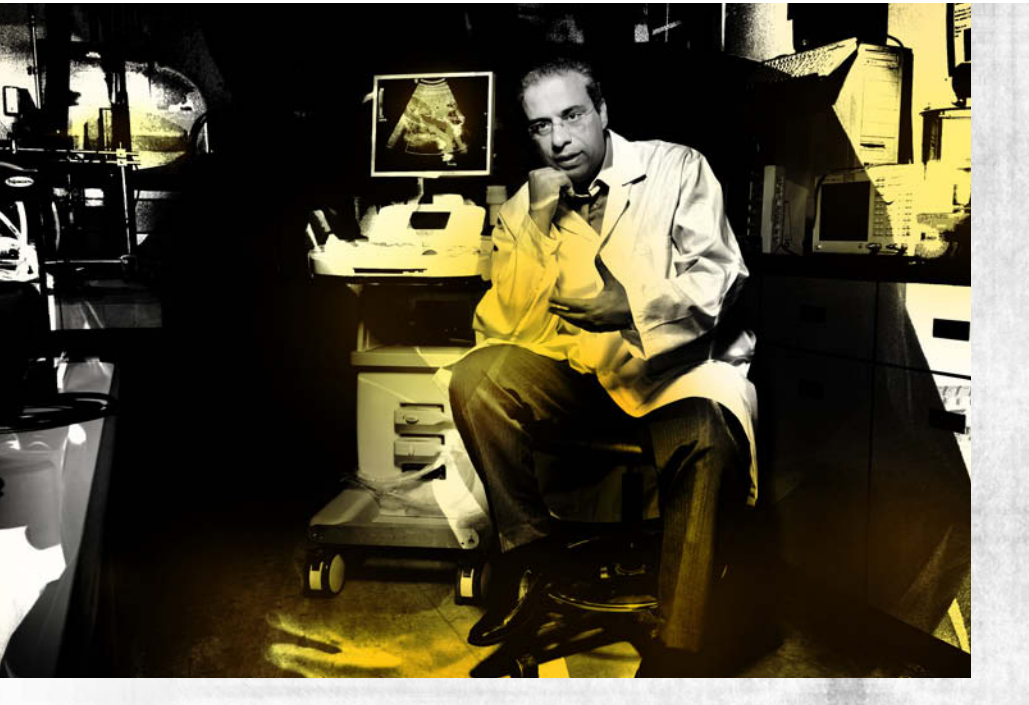
To date, Karshafian and Kolios, working with oncology partners at the University of Toronto and Sunnybrook Health Sciences Centre, have shown that the combination of ultrasound and microbubble treatment with chemotherapy and radiation therapy improves therapeutic results in both cells and tumours implanted in mice. In addition, their experiments have revealed that ultrasound imaging can guide the application of therapeutic ultrasound in order to target treatments on specific tumour tissues while sparing surrounding healthy tissues.

“Our ultimate hope,” Kolios says, “is that the ultrasound therapy and imaging systems we are developing will have a major impact on patient care by improving clinical outcomes and overall well-being while undergoing treatment.”

■ Raffi Karshafian (below, right) with master of science student Tetyana Yatsenko, and Michael Kolios (bottom), are developing ultrasound systems to improve cancer treatment.



bloodless surgery adapting biomedical ultrasound for clinical treatment



■ Jahan Tavakkoli researches high-intensity focused ultrasound which enables surgical precision with minimal side effects.

“HIFU works by rapidly converting intensive ultrasound energy into heat, resulting in temperature elevations above 65 C within a small focal zone that’s deep seated in tissue,” explains Tavakkoli. “Due to its highly focalized nature, the HIFU beam doesn’t affect intervening tissues and organs, and it enables a high degree of surgical precision with minimal side effects.”

jahan tavakkoli
department of physics

Ultrasound is one of just a handful of modalities in medicine that have both diagnostic and therapeutic applications. Safe and relatively inexpensive, it holds enormous promise for patients and Canada’s health-care system.

The focus of Jahan Tavakkoli’s research is on developing novel therapeutic applications for biomedical ultrasound. His research and development activities are expanding knowledge and clinical approaches in the fields of oncology, neurosurgery, pain medicine and cosmetic surgery.

Tavakkoli’s investigations in therapeutic ultrasound range from high-intensity focused ultrasound (HIFU) to low-intensity pulsed ultrasound (LIPUS). The former – HIFU – is sometimes known as a “bloodless surgery” modality. It is a non-invasive technique that potentially eliminates the need for open surgery and general anaesthesia in many surgical procedures.

Tavakkoli’s research program is supported by grants from the Natural Sciences and Engineering Research Council of Canada and the Ontario Ministry of Economic Development and Innovation and several Ryerson research funds. In his work, he draws on his experience (more than 15 years) in the medical devices research and development sector before he joined Ryerson. Tavakkoli was involved in the development of three HIFU devices that are used in clinical applications: the Sonablate 500 for treating prostate cancer; the Sonatherm 600 for treating kidney cancer and DeepSee for facial cosmetic surgery.

“As a Ryerson faculty member, I’m connected to other researchers in the Greater Toronto Area and abroad who are conducting world-class biomedical ultrasound research,” says Tavakkoli. “It is especially stimulating to have so many opportunities to collaborate with clinicians and industrial partners on translating my research into real-world products for clinical applications.”

molecular power taking biochemical aim at cystic fibrosis

■ Russell Viirre synthesizes prospective drugs for cystic fibrosis.



russell d. viirre
department of chemistry
and biology

Cystic fibrosis (CF) is a genetic disorder that affects one in every 3,600 children born in Canada. Sadly, there is no cure for CF, the most common fatal genetic disease affecting Canadian children and young adults.

Research by Russell Viirre and his graduate students, however, is pointing in promising directions. "Our objective," Viirre says, "is to design new molecules that could eventually form the biochemical basis of life-saving drugs."

Supported by the Canadian Institutes of Health Research, Viirre's work is an example of medicinal chemistry: the science of building new molecules, testing and quantifying their biological activity, and then using that information to engineer new, more potent molecules. Viirre is investigating the mechanism by which a recently discovered small molecule is able to rescue and repair the damaged protein molecule responsible for the disease.

Since 2007, Viirre's CF-related research has been conducted in co-operation with Toronto's Hospital for Sick Children. "Dr. Christine Bear and her team at SickKids are experts in handling the CF protein. In our laboratory at Ryerson, we design and synthesize new probe molecules, which the Bear group then use in experiments with the protein."

So far, Viirre and his team have built a series of probe molecules, and they published some of their findings in late 2011. Their efforts are enabling biochemical experiments at SickKids aimed at further narrowing down the precise dynamics of the CF protein's interaction with the small molecule.

Back at Ryerson, Viirre explains, the next step is to look at other molecules reported to have beneficial effects on the CF protein: "Do they have the same interactions, or do they hit the protein in other ways? What we discover will help us to ultimately design very potent, specific molecules with the potential to be an effective treatment for CF."

accessible and inclusive systems and services

A good health system delivers quality care to all people, when and where it's needed

Our health-care researchers focus on improving access to health-care for underserved groups, on improving efficiency and effectiveness and promoting inclusion to enhance well-being. **Donna Koller's** work has produced key recommendations for health-care professionals working with child patients to decrease the children's stress level, allowing them to take an active role in their care. Meanwhile **Faith Donald** is researching ways to enhance incorporation of nurses and nurse practitioners in the Ontario health-care system through discovery, integration and application. Under the guidance of **Judy Finlay**, the Ryerson-led project Mamow Ki-ken-da-ma-win (searching together) brings together the North-South Partnership for Children and includes First Nations members from Northern Ontario. They work closely with researchers from four Ontario universities and more than 100 community partners from southern Ontario to determine their communities' greatest needs and the obstacles to child, family and community wellness. **Janet Lum** focuses on services to aging populations. **Deb Fels, Jason Nolan** and others focus on strategies and technologies to promote inclusion and well-being.



kid-friendly communication helping sick children cope better

donna koller
school of early childhood
studies

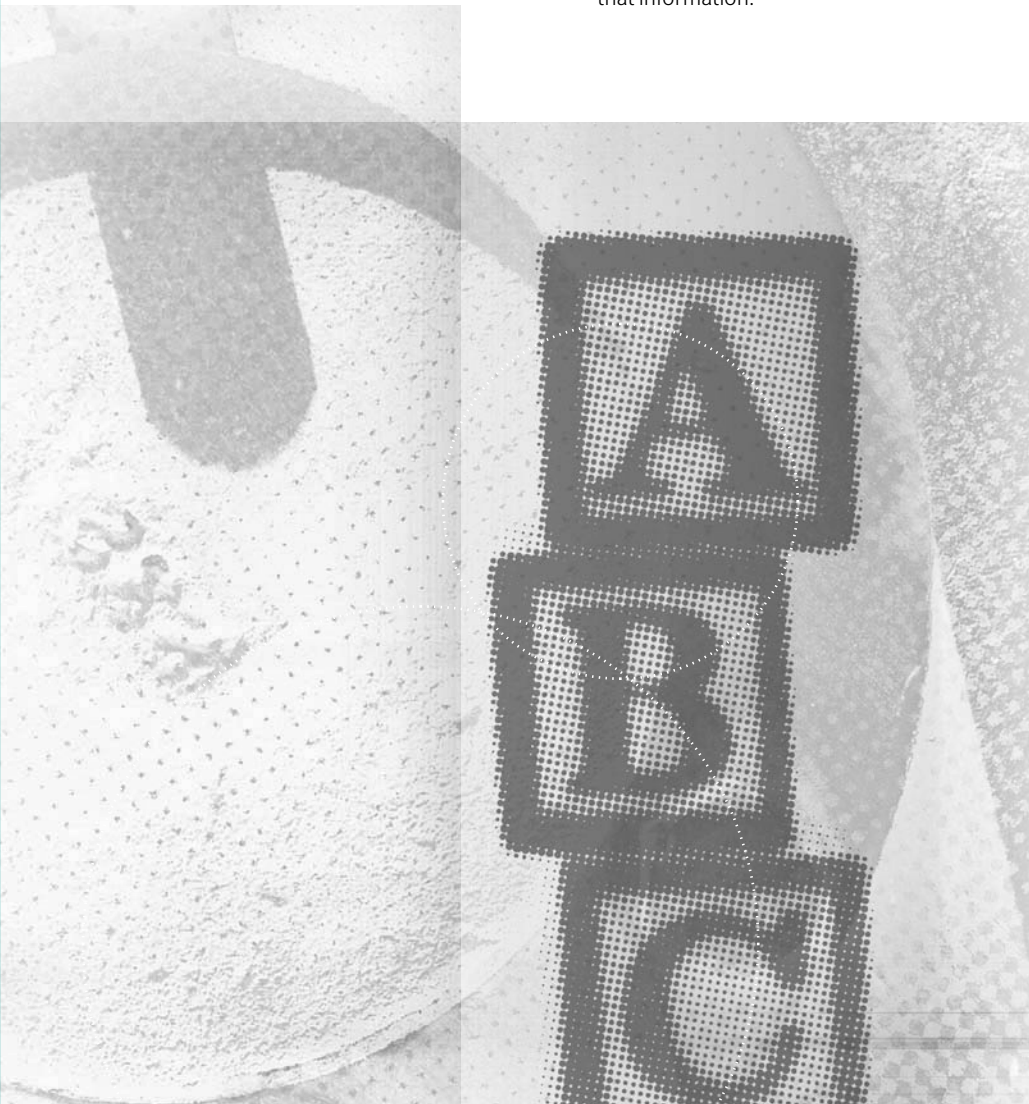
In health care, patient-centered care ensures that patients are given accurate health information and their participation is encouraged in all areas regarding treatment plans. However, in pediatrics, the notion of patient-centered care is more complex given that young children may not be given opportunities to participate in their care or decision-making. "Child patients aren't always included in decisions or told what's happening to them," says Donna Koller, "despite the fact that hospitals have a clear mandate to provide that information."

A professor in early childhood studies and an adjunct scientist with the Research Institute at Toronto's Hospital for Sick Children (SickKids), Koller has conducted research into the role of communication with child patients and how children perceive their health-care experiences. Recently, Koller and co-investigators at SickKids, the University of Calgary and Cape Breton University, completed a study entitled Listening to the Voices of Children and Adolescents with Chronic Illness. Supported by a grant from the Canadian Institutes of Health Research, this project documented the range of experiences children have while in hospital and the importance of listening to children's requests and providing them with information about their condition.

First, such kids are more likely to participate in their own self-care, an outcome that can have a major impact on managing chronic conditions such as diabetes, asthma and cystic fibrosis. Second, enhancing a child's understanding of a medical procedure can significantly reduce his or her fear and eliminate misconceptions.

These and related discoveries have led Koller to make recommendations aimed at improving care for children. Koller urges health-care professionals to develop appropriate listening skills, acknowledge children's wishes (even if they cannot all be acted upon) and use language that kids can easily understand.

"You would never walk into an adult hospital and find patients who don't know why they are there," Koller says. "But that, in fact, happens regularly in children's hospitals."



Filling the gap integrating nurse practitioners into the health-care system

faith donald
daphne cockwell school
of nursing

Nurse practitioners (NPs) can diagnose and treat illnesses, order and interpret diagnostic tests and prescribe medications. These advanced-practice registered nurses possess additional education and skills in health promotion, disease prevention and the treatment of common illnesses.

Given the rising costs of health care, the increase in chronic diseases and the shortage of physicians, many believe that employing more NPs will contribute to system sustainability while still ensuring excellent care. However, knowledge is evolving when it comes to how best to integrate NPs into specific health-care settings.

With colleagues at Dalhousie and McMaster universities, and the Universities of Waterloo and Victoria, Ryerson's Faith Donald recently completed a nation-wide study examining the integration of NPs into long-term care (LTC) settings. "When people are admitted to nursing homes and homes-for-the-aged today," Donald says, "the majority tend to be sicker and frailer than those admitted just a few years ago. NPs assist in filling the gap: they help LTC nurses gain knowledge and skills to care for residents who have complex needs, and they provide on-site support, as well as medical and advanced nursing care for people who, without the NP, would have to stay in hospital."

Funded by the Canadian Institutes of Health Research, the British Columbia Ministry of Health Services and the Nova Scotia Health Research Foundation, Donald's project showed that, although few in number, NPs are well integrated into their LTC organizations. Some are working full-time in one or multiple facilities, while others divide their time between LTC and primary care settings. Not only are NPs highly regarded by members of the health-care team, but LTC residents and their family members are extremely satisfied with the improved quality of care, communication and support NPs provide.

■ Faith Donald studies how nurse practitioners make a difference to patients' health in long-term care facilities.



northern roots partnering with first nations to help heal communities

judy finlay
school of child and
youth care



■ Judy Finlay is a member of a partnership that aims to understand the social and historical conditions that affect the health of First Nations' communities.

Imagine living in a place where only one-tenth of the population has jobs, suicide rates are 100 times higher than the national average, over half of the children frequently go hungry, and many people lack safe drinking water. This is the situation aboriginal people living in Canada's remote northern communities often face.

"The effects of forced relocations, confinement and other colonization tactics have a devastating impact on children and families in many indigenous communities," says Judy Finlay, the co-chair of Mamow Sha-way-gi-kay-win: North-South Partnership for Children. This project brings together 30 Northern Ontario First Nations communities with university-based researchers and 20 non-governmental organizations. The partnership's goal is to understand the social and historical conditions that affect community members' health, and then use that knowledge to develop capacity-building plans.

Finlay's work on aboriginal health issues is informed by more than three decades of involvement in children's welfare and mental health, including service as Ontario's Child Advocate (1991-2007). These experiences taught her that "meaningful community-development work requires hearing directly from First Nations' elders, families and kids."

The North-South Partnership has already made solid progress, including water purification systems, soil assessments aimed at re-starting agriculture, and accessibility-focused home renovations. For Finlay, though, the major gain has been the relationships forged between Aboriginal and non-Aboriginal Peoples. "These form the basis of meaningful reconciliation and are the pre-condition of any initiative."

In collaboration with the North-South Partnership, Finlay is also guiding the Ryerson-led project Mamow Ki-ken-da-ma-win: Searching Together. Funded by the Social Sciences and Humanities Research Council of Canada, Finlay and her co-researchers are using a partnership-based approach to address the social determinants of health afflicting 12 First Nations communities in Northern Ontario.

Healthy aging The value of home and community care

Janet M. Lum
Department of Politics and
Public Administration

Canada's population is rapidly aging. While many older people are remaining healthier for longer than was the case in previous generations, the cost of caring for their health and well-being is on the rise.

The sums allocated by governments across the country are not, however, keeping step with this increasing need. For example, while about 40 per cent of Ontario's annual budget is for health care, roughly two per cent of that amount goes directly to community agencies that provide home and community care.

According to Janet Lum, one of the main reasons for this "paltry level" of spending is the absence of evidence proving that such investments are a cost-effective way of keeping people at home (where they wish to be) and preventing unnecessary hospital visits. "My mission is to gather and synthesize the best available evidence on home and community care," says Lum. "A big part of that mission is also to ensure the data get into the hands of Canada's policy planners and decision-makers."

As co-chair of the Canadian Research Network for Care in the Community (CRNCC), Lum is at the helm of a network that brings together more than 500 national and international academic and community researchers; professional, health, social and community-care providers; consumers; policy-analysts; and students. Funded by Ryerson University and the Social Sciences and Humanities Research Council of Canada, the CRNCC supports collaborative, community-driven research and knowledge translation in home and community care (see www.crncc.ca).

"When we integrate health-care with home and community care, and when we manage it around individuals' needs, we can improve the quality of older peoples' lives and help maintain their independence." Lum believes that taking this approach is also one of the best ways to help sustain Canada's health-care system because it reduces the use of more expensive acute and institutional care. "Sound policy," Lum observes, "can lead to excellent care for older people and effective financial management of the public purse."

■ Janet Lum gathers data to show how home and community care improves the quality of older peoples' lives.



spinal chords making music for people who can't hear



deborah fels
ted rogers school of
information technology
management

■ Deborah Fels breaks new ground for people with sensory-related disabilities.

Listening to music is an emotional experience. Notes, keys, tempos, melodies – all the components of music combine to generate emotion-driven responses. For people who are hard-of-hearing or deaf, however, this remarkable aspect of the human condition is sharply curtailed or even absent.

Drawing on her background as a professional engineer and her expertise in human-factors interface design, Deborah Fels worked with partners in the arts, industry and academia to develop a technology that overcomes this heavy burden. Called the Emoti-chair, this device translates musical frequencies into vibrotactile stimulation along a listener's spine.

Fels is the director of Ryerson's Centre for Learning Technologies. Several years ago, she realized that "bonding factual content with emotional content would open up new learning and entertainment experiences for deaf or hard-of-hearing individuals. I therefore envisioned a truly inclusive, synergized experience that would be available regardless of any disabilities a person might have."

Users of the Emoti-chair report that the sound frequencies they detect through their skin evoke feelings and emotions very similar to those that other people experience when they listen to music. Since its creation in 2007, the Emoti-chair has been featured in live concerts, a movie night, Nuit Blanche, video-gaming events, the Ontario Science Centre and a permanent display at Toronto's Deaf Culture Centre.

Fels continues to break new ground for people with sensory-related disabilities, with support from the Ontario Partnership for Innovation and Collaboration, the Natural Sciences and Engineering Research Council of Canada, Social Sciences and Humanities Research Council of Canada, the Graphics, Animation and New Media (GRAND) a Network of Centres of Excellence, FedDev Ontario, and the National Institutes of Health in the United States. In addition to refining the Emoti-chair, she is working on software applications involving emotive captioning and music visualization, audio description using LiveDescribe and online sign language web pages with SignLink Studios.

Adaptive design supporting children who have disabilities



jason nolan
school of early childhood
studies

Children with disabilities rarely get sufficient support for even their basic needs. Yet, it has been proven often that the more assistance they receive early on, the greater the chance of success they will have later in life – in education, careers, relationships and other pursuits.

According to Jason Nolan, the director of Ryerson's Experiential Design and Gaming Environments (EDGE) lab, the field of Adaptive Design (AD) holds great promise for helping such children thrive. AD, Nolan explains, "is rooted in the belief that we need specific tools and techniques to modify physical environments cheaply and easily, so that children with disabilities can participate barrier-free in play, learning, family life and the community."

■ Jason Nolan is interested in tools that modify physical environments so that children with disabilities can participate barrier-free in play, learning, family life and the community.

In this context, Nolan focuses his research on tools that increase children's autonomy. One of Nolan's main efforts has involved using cardboard and other easily accessible materials to engineer custom adaptations, therapeutic seats, play tables and computer kiosks. Recently, he has also extended AD into soft-circuitry and wearable computing, such as garments that can allow non-verbal children to speak. His work is supported by the Canadian Foundation for Innovation; the Ontario Ministry of Economic Development and Innovation; the Social Sciences and Humanities Research Council of Canada; and Graphics, Animation and New Media (GRAND) a Network of Centres of Excellence.

"I don't take a 'medical' view of health," says Nolan. "Instead, I see health as rooted in curriculum and pedagogy. I work directly with children to create new designs that extend their ability to interact with and engage the world around them and, in some cases, to acquire the skills to help others."

Nolan is also active in spreading AD-related knowledge and best practices among fellow scholars and practitioners. A member of the advisory boards of the Adaptive Design Association and the GimpGirl Community, Nolan is the founding co-editor of the journal Learning Inquiry and he co-edited the International Handbook of Virtual Learning Environments.

mind control

A novel prosthetic device guided by the brain's own signals

Michal Prywata and
Thiago Caires
Bionik Laboratories Inc.,
Digital Media Zone

Depending on their microelectronics and motors, many prosthetic arms currently on the market easily run over \$80,000 per unit. In addition, the most sophisticated of these devices require patients to undergo complex surgery, which costs about \$300,000 and is neither available in Canada nor covered by provincial health plans.

While enrolled in Ryerson's undergraduate biomedical engineering program, Michal Prywata and Thiago Caires devised a prosthetic arm unencumbered by these financial and surgical burdens. "In addition," Caires notes, "our device allows a range of movement considerably broader than is possible with traditional models."

The duo's Artificial Muscle-Operated (AMO) Arm is controlled by the brain and uses compressed air as its main source of power. Even after a limb is amputated, the brain continues to send out movement-related signals. AMO Arm users wear a head-set that senses such signals and sends them wirelessly to a miniature computer in the arm. The resulting information is sent to the arm's pneumatic system, which, in turn, activates the device.

Traditional prosthetics may require weeks of learning and training. By contrast, Prywata says, "A person can pick up the AMO Arm's mind-control aspect in about 10 minutes of practising. Our unique signal-acquisition system means that users can, in essence, deploy their thoughts to control their arms, much as people do who have not had a limb amputated."

Since developing the prosthetic arm, Prywata and Caires have gone on to found their own company, Bionik Laboratories Inc. This venture was supported by a residency in the Digital Media Zone, an experience that connected the pair to organizations that fund medical research and development as well as with business leaders to help them commercialize the AMO Arm and related health technologies.

■ Michal Prywata (left) and Thiago Caires: As students, they invented a prosthetic arm that's much less expensive and much easier to use than traditional devices.



CENTRES/INSTITUTES

■ institute for stress and wellbeing research

Everyone at some point in life experiences stress; in fact, one in four Canadians between adolescence and age 65 reports high levels of stress. When stress becomes chronic, however, it can seriously degrade individuals' quality of life and undermine their physical health and emotional well-being.

Stress – the subjective experience of disease – is associated with underlying biological changes to the brain and body. This underlying biology can predispose a person to disease and accelerate the cognitive aging process; it has also been linked to smoking, sleep disorder, depression, anxiety, immune system suppression, diabetes and heart disease. Prenatally, maternal stress influences foetal physiology, and chronic stress is associated with age of mortality.

Ryerson University's Institute for Stress and Wellbeing Research was founded in January 2011 to conduct integrated research in stress for the purposes of both understanding and intervention. "Fundamental questions remain unanswered about this considerable public health issue," says the institute's director, Leslie Atkinson, a noted researcher in the field of stress in infancy. "Stress encompasses subjective, endocrinological, neural, autonomic and cognitive-behavioural aspects, yet we know relatively little about each of them and almost nothing about their interrelations."

Supported by the Ontario Ministry of Economic Development and Innovation and matching funds from Ryerson, the institute's diverse faculty amalgamates expertise in biological, cognitive-behavioural and subjective aspects of stress. This structure permits a team-based, multi-faceted approach to the Institute's investigations.

■ ontario multicultural health applied research network

Ontario is one of the world's most multicultural jurisdictions. As health-care practitioners seek to provide excellent care for all, a major challenge they face is the lack of a strong knowledge base to draw on in providing care to people from diverse ethno-cultural backgrounds who may be differently affected by various physical and mental illnesses. There is also evidence that ethno-cultural minorities are less likely than their fellow citizens to engage in health promotion and disease-prevention activities due to lack of culturally and linguistically appropriate information and services.

Launched in spring 2011, the Ontario Multicultural Health Applied Research Network (OMHARN) brings together the Ontario-based researchers, health, social- and settlement-service providers and policymakers in the field of multicultural health. OMHARN is a collaboration between Ryerson University and York University, in partnership with the Health For All Clinic at the Markham-Stouffville Hospital. Funded by the Ontario Ministry of Health and Long-Term Care, OMHARN's overarching goal is to build the knowledge base required to support patient-centred and integrated care across multiple access points.

"We aim to generate high-quality research and to synthesize existing knowledge," says Usha George, dean of Ryerson's Faculty of Community Services. "This will enable us to inform health planning, clinical practices, and policies that support culturally safe, effective and equitable health services across the province." George further notes, by showcasing Ontario as "a hub for multicultural health," OMHARN will have the potential to promote developments at the national and international levels.

www.ryerson.ca/omh

■ computational biomedical physics laboratory

The use of nano-particles is one of the most promising developments in biomedicine today. In particular, there is great interest in the scientific community in deploying nano-particles to combat cancer.

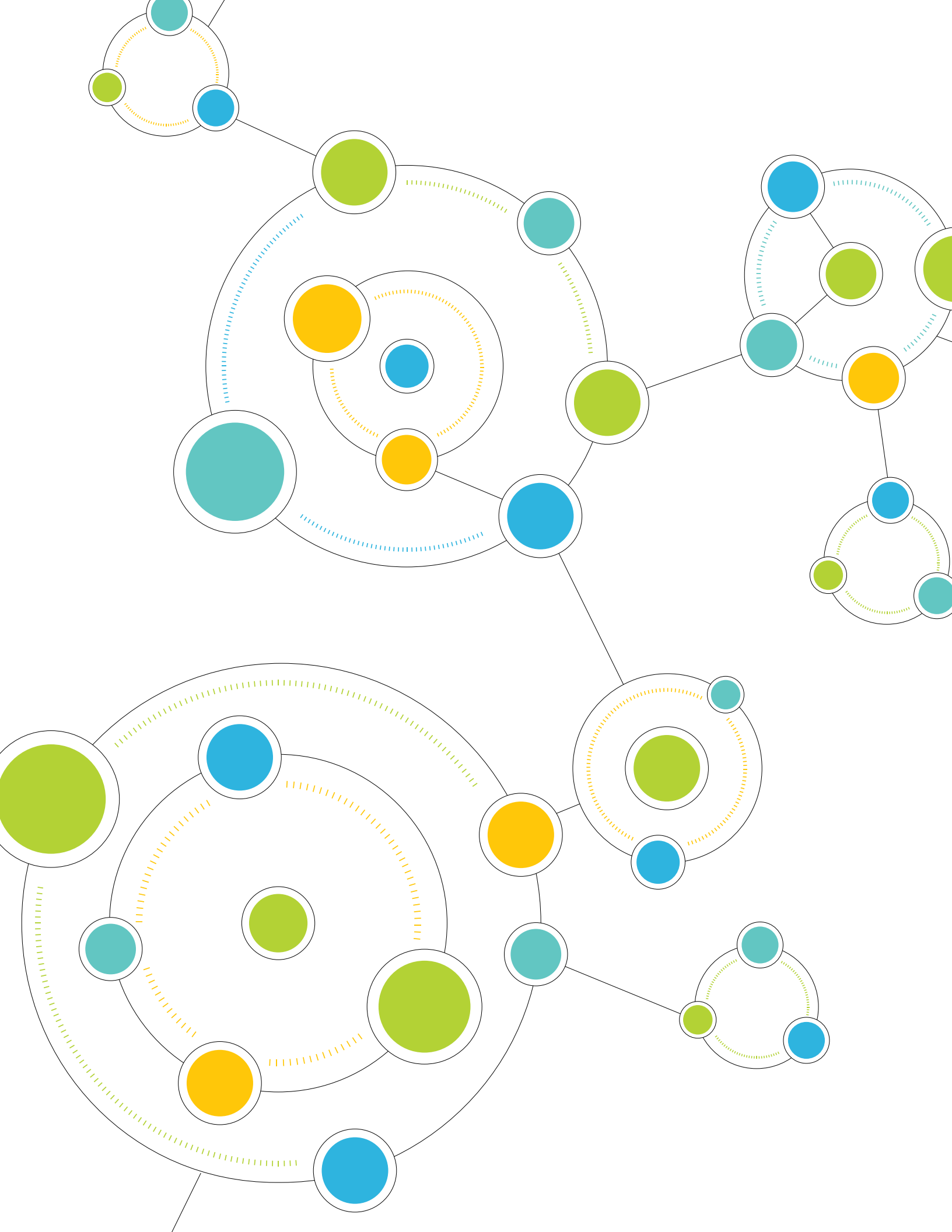
"Nano-particles can be targeted for uptake in tumours," explains J. Carl Kumaradas, the director of Ryerson's Computational Biomedical Physics Laboratory (CMPL). "This is done by coating the nano-particles with cancer-targeting peptides. Then, once they have been localized in a tumour region, the nano-particles can enhance the detection and destruction of tumours."

The CMPL is supported by funding from the Natural Science and Engineering Research Council of Canada, the Canadian Institutes of Health Research and Mitacs. Kumaradas and his fellow researchers are focusing their research on gold nano-particles (GNPs) and super-paramagnetic iron-oxide nano-particles (SPIONs).

Because GNPs can be designed to absorb light, lasers can be used to heat only the tumour region. This process destroys tumours while sparing normal tissue. Currently, CMPL researchers are using computer models to characterize GNPs' optical behaviour. SPIONs, meantime, can heat their surroundings when exposed to external alternating magnetic fields. Kumaradas and his colleagues are developing computer models for studying the electromagnetic and mechanical behaviour at the single particle level as well as particle-to-particle interactions.

"Our main goal is to aid in the development of novel biomedical devices," says Kumaradas. "As well, CMPL research holds great potential to advance understanding in other areas of science and engineering, such as power.

www.physics.ryerson.ca/research/comp_bio



funding partners

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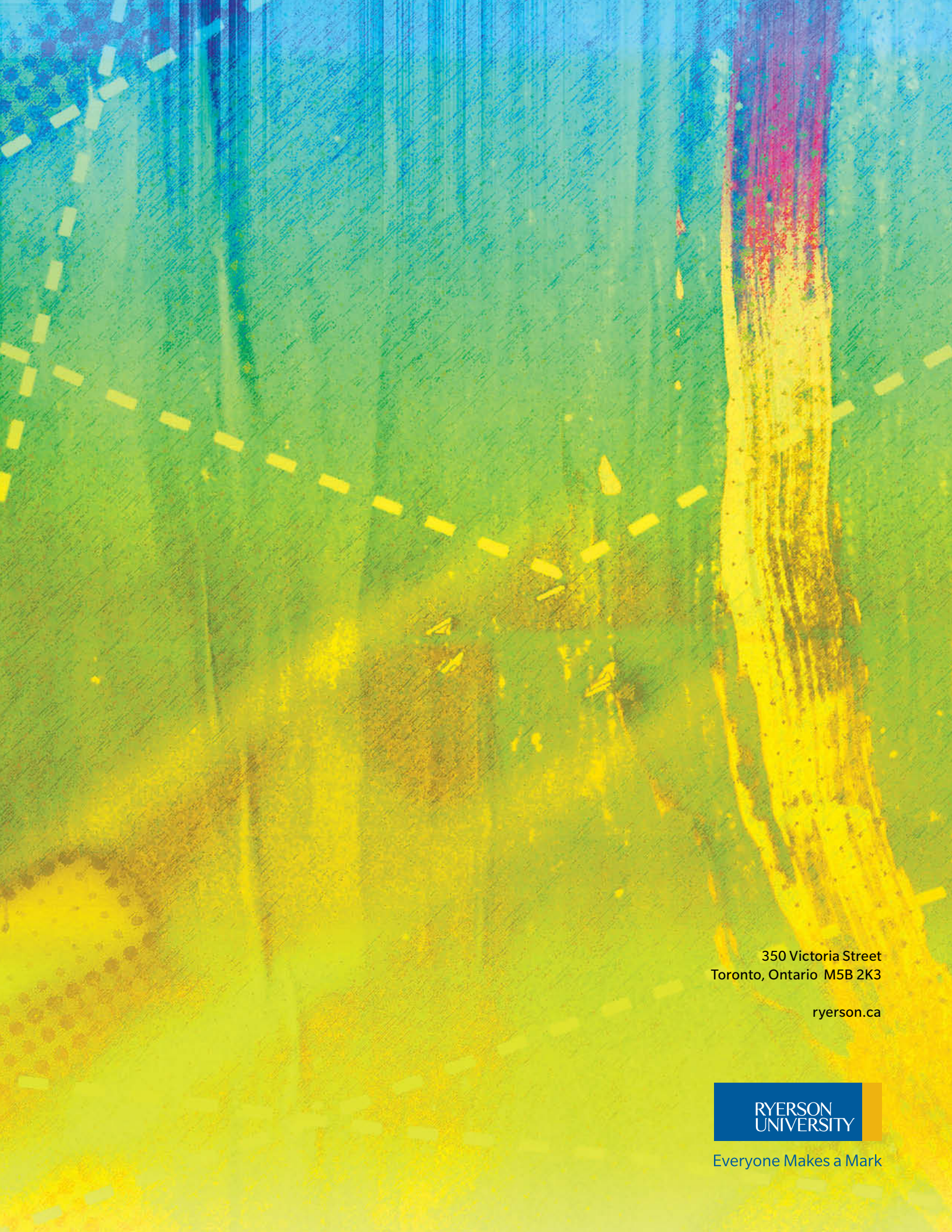
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