ANNUAL REPORT 2022

Centre for Health Innovation

Centre for Health Innovation

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MESSAGE FROM THE DIRECTOR

We have all been affected by health challenges as we endured and now emerge from a global pandemic. The pandemic highlighted the need for a highly interdisciplinary, “all hands on deck” approach to problem-solving in health care. The newly formed Centre for Health Innovation (CHI) is an evolution, born of our times, that aims to innovate with this approach.

Our urgent mission is to address critical challenges to human health by leading in high-quality biomedical research. The generation and implementation of knowledge that can interrupt disease and improve health outcomes require access to state-of-the-art tools, patient samples and data, and clinicians. CHI is proposing a comprehensive approach to removing barriers to research so that members of the Queen’s and KHSC community can engage in world-class, collaborative research activities that directly benefit patients.

You can read about the full history of CHI (and its origins as the Human Mobility Research Centre) from a historical perspective provided by Tim Bryant (Appendix 1). CHI is born out of five decades of interdisciplinary strengths that began with Charles Sorbie in 1968 – we strive to leverage and synergize these strengths as we usher in a new era.

I hope you enjoy this report and the potential for what we can all do together.

Amber Simpson
CHI Director
Canada Research Chair in Biomedical Computing & Informatics

HIGHLIGHTS

Strategic Planning

- The new centre was named the Centre for Health Innovation (CHI) and launched with the first annual symposium.
- Substantial new core facilities are being built in collaboration with partners that will benefit all investigators at Queen's and KHSC.
- Highly productive interdisciplinary research projects were executed.

Financial Highlights

A new pay-per-service model has been implemented resulting in a projected budget surplus of $241,432 by the end of the fiscal year 2022/2023 that can be re-invested in new programs and supports for researchers.

Operating Highlights

- Investments in state-of-the-art equipment and space mean that investigators have the facilities to lead world-class research.
- The ongoing development of a business model will ensure the sustainability of the centre and its staff.

Looking Ahead

CHI is a partnership between Queen's University and Kingston Health Sciences Centre, which presents many opportunities. CHI's critical path is to formalize our centre status with both institutions.

THE CENTRE FOR HEALTH INNOVATION

The Centre for Health Innovation (CHI – pronounced “CHEE”) is a joint venture of Queen’s University and Kingston Health Sciences Centre. Our vision, mission, and goals were developed through a consultation process with many stakeholders in January 2021 with facilitators from Shift Health. The centre was formally launched on June 6, 2022.

Vision

Transformative health solutions that redefine better health for all.

Mission

To address the complexity of human health challenges through a radically interdisciplinary approach.

Goals

1. Lead in health innovation through programs of excellence in research, outreach, and cost-effective patient care.
2. Provide a hub of intellectual activity for university faculty, clinicians, graduate students, residents, and the community to engage in collaborative, interdisciplinary health research.
3. Reduce the barriers for the research community to access state-of-the-art shared resources and specialized facilities.
4. Work with urgency.

Logo

The new logo represents the collaboration of three faculties (Arts & Science – Blue, Engineering and Applied Science – Gold, and Health Sciences – Red) brought together by Kingston Health Sciences Centre (Purple).

Centre for Health Innovation

ACTIVITIES

Symposium and Launch of the Centre

CHI officially launched on June 6-7, 2022 with a symposium on the theme of "Innovation for Good". The meeting occurred during the first week of the lifting of COVID restrictions by the province. We hosted 23 team talks, 10 student talks, 21 student posters, 2 panel sessions, a live demo of motion tracking, and a keynote presentation. With over 40 attendees in person and another 100 participating online, the symposium brought together investigators with the common goal of improving human health. See Appendix 2 for the program. The event was a resounding success – giving many researchers in attendance the opportunity to collaborate in person for the first time in two years.

Rachel Theriault, Mahsa Zojaji, Amber Simpson, Ramtin Mojtahedi Saffari, Kenna Bartlett

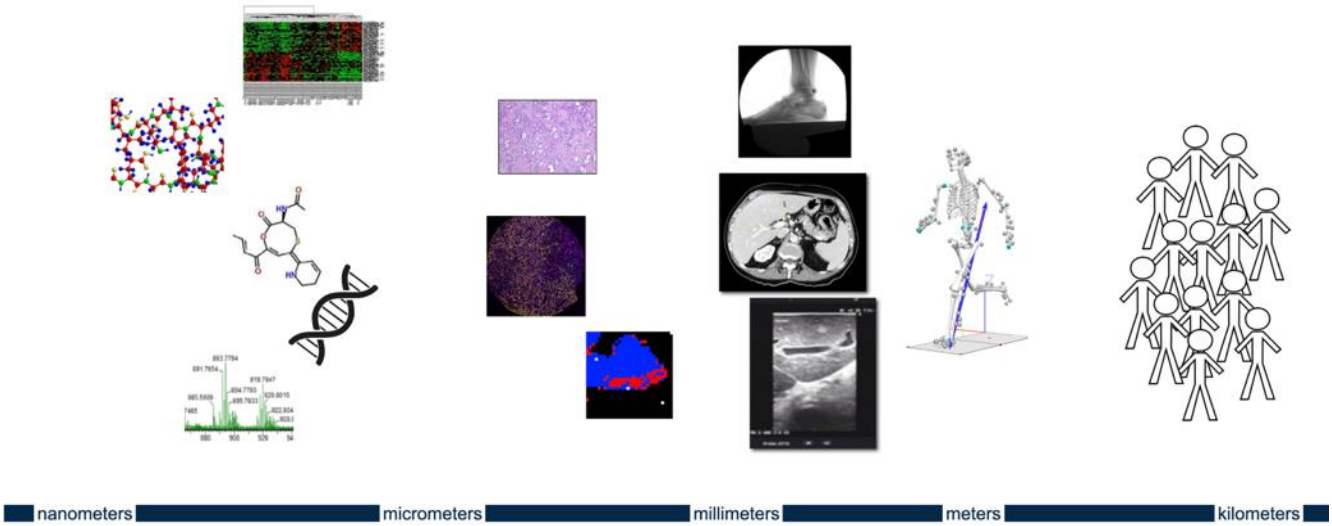
The following students received $500 awards, voted on by attendees:

- **Kenna Bartlett (Best Poster), MSc Student, Mechanical and Materials Engineering**
  Predictive model from factorial analysis of factors affecting glenoid baseplate micromotion in reverse shoulder arthroplasty
- **Rachel Theriault (Best Poster), PhD Student, School of Computing**
  Finding patterns in mass spectrometry images
- **Mahsa Zojaji (Audience Choice), MSc Student, Mechanical and Materials Engineering**
  Quantifying the contribution of dietary mineral intake to cortical bone mechanical properties under compressive loading using finite element analysis
- **Ramtin Mojtahedi Saffari (Audience Choice), PhD Student, School of Computing**
  Tumor segmentation in colorectal liver metastasis using an optimal vision transformer patch resolution

Cells to Communities: CHI as a Hub for Understanding Biological Scales

The cells to communities (C^2) concept has emerged as a unifying theme for CHI activities. Originally proposed by Heidi Ploeg and Brian Amsden, C^2 exploits HMRC's established track record in biomechanics, cell manufacturing, and tissue engineering, with new approaches in omics at every biological scale.

With C^2, CHI is proposing a multi-scale, computational + experimental approach from Cells to Community that will connect mechanobiology with healthy active living, finding new solutions for promoting health and wellness in Canada's aging population. Cellular and tissue mechanobiology and omics complete the connection between cells and community, leveraging Queen's established labs and expertise in cell biology, biomaterials, biomechanics and community-based research. Data-driven predictive models will be developed grounded in biophysical principles for system identification at multiple scales that will connect with molecular targets (for example) to develop new therapies. The team's focus is to translate our knowledge and discoveries to create new methods, technologies, and intuitive human-machine interactions to promote community participation and, in turn, benefit the physical health and wellness of Canadians of all ages.



Connecting Biological Scales (from Nano to Populations) is Key to Driving Treatment Decisions that Effect Patients

SELECT COLLABORATIVE HIGHLIGHTS

Clinical Trials and Prospective Specimen Collections

CHI provides support for clinical trials and biospecimen collections. In 2022, we supported:

34 trials and specimen collections

14 investigators

2 faculties

5 departments

CHI provides the following support on a pay-per-service basis for researchers:

- Site feasibility requests
- Study methodology
- Ethics (submissions, amendments)
- Regulatory paperwork
- Reporting
- Patient consents
- Scheduling patient follow-ups
- Protocol deviations, SAE reporting
- Contract review
- Protocol development/review
- Site initiation and training
- Data analyses
- Monitoring visits
- Research accounting
- Records management
- Manuscript preparation

Terry Fox Marathon of Hope

Queen's University and the Kingston Health Sciences Centre (KHSC) joined the Marathon of Hope Cancer Centres Network. The network, which is led by the Terry Fox Research Institute (TFRI), is uniting cancer centres across Canada to accelerate the implementation of precision medicine so that Canadian cancer patients can access the right treatment at the right time for their cancer, no matter where they liv

Through our inclusion in the network (led by Amber Simpson, CHI Director), Kingston will be linked with top cancer hospitals and research centres around the country. Together, these organizations are sharing resources and knowledge to create a high-quality database comprised of clinical and genomic data from over 15,000 cancer patients that reflect the entire Canadian population. This unique dataset will be analyzed using new technologies such as artificial intelligence to advance our understanding, diagnosis, and treatment of cancer in ways that significantly impact patient outcomes.

Harriet Feilotter, Amber Simpson, Heather Grant, David Berman, and Andrew Craig

The new partnership will include funding of up to $300k from the TFRI over the next year for research involving patients with aggressive brain cancer (led by Teresa Purzner) and bladder cancer (led by Rob Siemens). Both cancer types have poor outcomes and require greater understanding and analysis. Patients enrolled in oncology trials will also be included (led by Dr. Andrew Robinson). The funding will support the capacity for whole genome/proteome sequencing, multi-plex immunohistochemistry and other state-of-the-art lab testing developed by Harriet Feilotter, Tricia Cottrell, and David Berman. The tests and data from this research will be made available to other Queen's researchers.

Markerless Motion Capture Technology to Evaluate Orthopaedic Patients

One of the primary goals of total knee replacement surgery is to restore a patient's mobility, but researchers require accessible tools to quantify important activities of daily living such as walking or using stairs. Recent advances in computer vision and machine learning approaches have led to the development of markerless motion capture technology that can measure how a

patient moves without the need for external markers. The Human Mobility Research Laboratory (HMRL) is studying how easily this technology can be used on patients in a hospital setting and what clinical tools need to be developed to help orthopaedic surgeons, for example, decide the right time for surgery or determine how well a surgical procedure restores a patient's mobility. Measuring mobility in a clinically accessible system has many potential future applications such as quantifying recovery after a stroke or identifying patients at risk of falling. The HMRL team are collaborating with researchers across Canada to develop these tools for a diverse patient population.

Elise Laende Demonstrating Markerless Motion Capture

Engineering Partnership with Burkina Faso

A Queen's Engineering partnership with a University in Burkina Faso promises to greatly impact the lives and health of those working in that country's largest industry.

Goods developed from yarn weaving, spun from cotton, contribute to an essential part of the Burkina Faso economy, but the physical demands of the work can lead to pain and injuries for its practitioners. To address these issues, a new partnership evolved through the long-standing relationship between researchers in Benin and Burkina Faso and Mechanical and Materials Engineering (MME) professor Genevieve Dumas.

With assistance from the Queen's International Research Fund, Dumas and professors Qingguo Li (MME) and Tim Bryant (MME)have begun a collaboration with Dr. Amidou Sawadogo at Université Joseph Ki-Zerbo centered on his novel ergonomic studies with Burkinabe weavers.

The team is working with Dr. Amidou Sawadogo of the Institut des Sciences du Sport et du Développement Humain (Sports Science and Human Development Institute) at the Université Joseph Ki-Zerbo, with support from The Canada Fund for Local Initiatives (CFLI). An examination of the critical issues of weaver health and working conditions resulted in an international collaboration: the ISSDH-FCIL Promotion Santé Des Tisseuses Par l'Exercise Physique.

"Queen's has expertise in mechanical design and also in biomechanics," Bryant says. "We were able to adapt existing exercise equipment so that it would focus on the muscles that Amidou wanted in terms of the weavers' activities. The project became developing outdoor exercise equipment that could be used by the weavers on their own time so they wouldn't need an instructor there to help them use that equipment."

Canadian Ambassador to Burkina Faso Lee-Anne Herman with a Community Member

Digital Twins and Ethics of Artificial Intelligence

A digital twin is a digital replica of a patient, generated from health data using state-of-the-art AI techniques that can be used for virtually testing therapies. While this technology could radically transform our approach to clinical treatments, substantial implications for patients and society must be considered. For example, would you want to know a dismal prognosis predicted by your digital twin? How would you act on this information – would you regard the choice as yours, or your fate as given by your twin? How would this change your identity? This application unifies the distinct concepts of digital twins and identity, while challenging our understanding of the very nature of the self. How can the AI design and development of the cancer twin anticipate the existential dilemmas

Jordan Loewen-Colon and Sharday Mosurinjohn at the CHI Symposium

they raise, and take meaningful account of the transforming sociocultural contexts required to integrate them?

CHI researchers (Sharday Mosurinjohn and Amber Simpson) are developing a cancer digital twin while in parallel, providing a contextual analysis of the ramifications of the digital twin by appealing to philosophical and neuroscientific thought on the nature of self and being. Researchers will further examine the anthropology of religion and digital cultures that illuminates how human nature and human futures can be positioned in relation to potential advances in AI.

Real-time Cancer Margin Detection

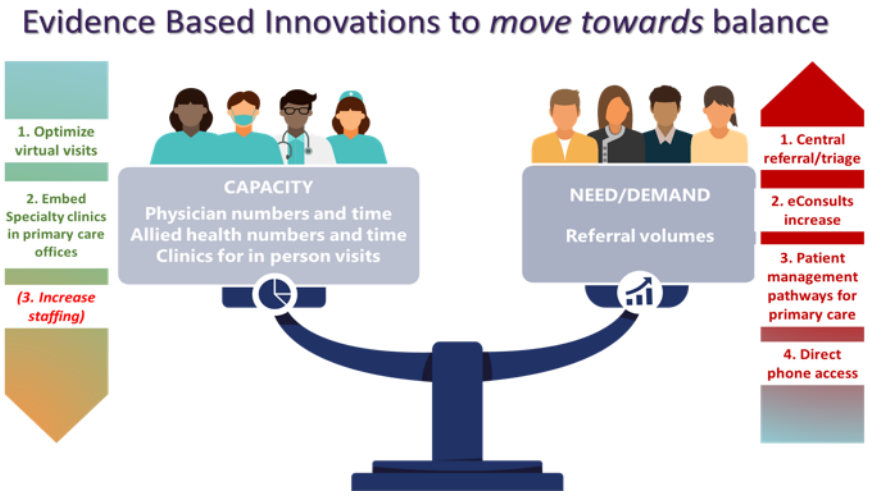
The iKnife is an operative tool that can detect cancer in tissues at the time of surgery. The intelligent knife is the coupling of rapid evaporative ionization mass spectrometry (REIMS) technology with electrosurgery for tissue diagnostics. Rapid evaporative ionization mass spectrometry is an emerging technique that allows near-real-time characterization of human tissue in vivo by analysis of the aerosol ("smoke") released during electrosurgical dissection. Mass spectrometry (MS) analysis of biological samples allows the simultaneous detection of metabolites, proteins and lipids directly from tissue sections.

Researchers from the Department of Surgery, School of Computing and Biomedical and Molecular Sciences have advanced this technology with the development of the NaviKnife, a next-generation imaging and software navigation system that can reduce the need for additional surgeries and significantly improve outcomes for cancer patients. The NaviKnife can achieve a complete tumour resection with minimal tissue loss. NaviKnife builds on novel multiparametric ultrasound imaging to accurately target cancer prior to resection, and novel real-time metabolomic tissue typing to identify and trace the tumour boundary during resection while guided by a simple robotic arm. While current research using this image-guided tool is directed at breast and brain cancer tumours, the broader vision includes integration into vascular and neurosurgery in addition to other kinds of oncosurgical areas. The NaviKnife is one example of how our clinician-scientists are working with industries to commercialize tools for global health.

KHSC Innovation Portfolio

Led by Elizabeth Eisenhauer, the KHSC Innovation Team is aimed at developing and deploying evidence-based innovations. CHI provides space to the team and is collaborating on two key projects.

Wait Times Initiative



Long wait times to access specialty consultation have been well documented in Canada. A 2020 survey of Kingston Health Sciences Centre (KHSC) specialists showed that ~50% of patients with non-urgent referrals wait more than 6 months and 25% wait more than 12 months for a specialist consultation. The ongoing COVID-19 pandemic has only exacerbated this. Since mid-2020, the initiative to Eliminate Wait Times for Specialty Access has been very active in looking at evidence-based interventions to improve capacity or reduce demand with support from KHSC, Queen's/SEAMO leadership and the Primary Care Physician's Council of FL&A.

Five Working Groups were established to tackle areas of evidence-based innovations. Membership was comprised of specialist and primary care volunteers along with patient representatives, administrative leaders and supported by project manager(s). Oversight by a Leadership team (KHSC, patients, Queen's, SEAMO, Primary Care Physicians Council) and expert advice from an Evaluation Team has been ongoing. Under the able leadership of Drs. Catherine Donnelly and Sidd Srivastava, the Evaluation Team with representation from each working group began their assessments in October 2020. An over-arching Logic Model is guiding the evaluation plan. Many of the key metrics are not collected within current administrative systems, therefore, for-purpose data will be required. Each WG is providing the key measures they wish to track for a) successful implementation, b) outputs, and c) impact. The work of the Evaluation team is supported by Alex Hamilton, Data Scientist in CHI.

Data Science, Digital Health, and Analytics

The place of "digital health" in KHSC and Queen's will only increase. The opportunities for using administrative and patient data for analytics resulting in better systems of care and patient management will be harnessed. New tools and technologies utilizing digital platforms for care and communication will continue to become more common. The Innovation workshop held in February 2020 on Digital Health, Machine Learning and AI underscored how our world is changing, and the importance of data use innovations to enhance the value of care and to understand and solve daily problems.

Alex Hamilton and Elizabeth Eisenhauer at CHI Symposium

Additional opportunities for increased collaboration in utilizing our own data (from our current information system and the future regional HIS) to develop solutions to problems in patient flow, integration of services, and patient care outcomes will increase.

One example in discussion involves how a better understanding of the characteristics, volume, and variation in types of patients coming to our Emergency Department, could lead to opportunities to deploy innovative solutions to the challenges around ER utilization and flow. Similarly, we are looking at optimizing OR scheduling to enhance throughput. We are in the planning stage with Kings Distributed Systems to pilot a novel machine-learning approach to block allocation.

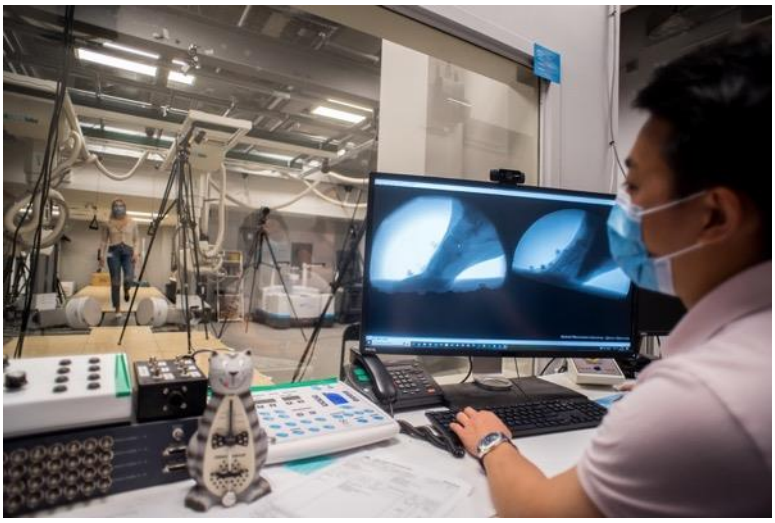
Skeletal Observation Laboratory Collaborations with Orthopedic Surgery

The Skeletal Observation Laboratory (SOL) has been collaborating with researchers in the Department of Orthopedics since its inception. This year, three primary collaborative projects have made substantial progress. First, David Pichora (Ortho), Parham Daneshvar (Ortho), and Mike Rainbow (MME) assembled a multi-disciplinary team of trainees in applied math, engineering physics, and medicine to examine the effects of various hand surgeries on functional outcomes. The team has been validating a novel approach to use a cadaveric wrist simulator that is coupled to an *in silico* simulator. Their approach examines the immediate mechanical effects of surgeries such as four-corner fusion. They directly measure changes in

joint range of motion and estimate changes in joint contact forces, which are essential for understanding and predicting patient-specific responses to treatment.

The second project leverages basic science outputs from the SOL to understand the pathomechanics of osteoarthritis in the foot. David Pichora, Rachael Da Cunha, Mike Rainbow, and colleagues in Kingston and the University of Queensland in Australia are preparing a CIHR proposal to conduct this investigation. In previous work, Mike Rainbow and former trainee Lauren Welte discovered that the foot's motion is essential to ankle function. Current treatments across the spectrum of foot pain and osteoarthritis do not account for the foot's mobility. The pending submission aims to better understand how changes in foot mobility alter function within the foot and lower extremities.

The final collaborative project is focused on understanding why specific morphological features of the scapula are strongly predictive of soft tissue injury and disease. To address this question, we are developing a novel approach to measure torque and motion at the shoulder. When coupled with our state-of-the-art biplanar video radiography and markerless motion capture systems, we may be the first to understand how the shoulder distributes loads across the scapulothoracic and glenohumeral joints. These comprehensive biomechanical measurements will assess shoulder function across various ecologically valid tasks while controlling for shoulder morphology. This collaboration includes Parham Daneshvar, Ryan Bicknell, and Mike Rainbow.



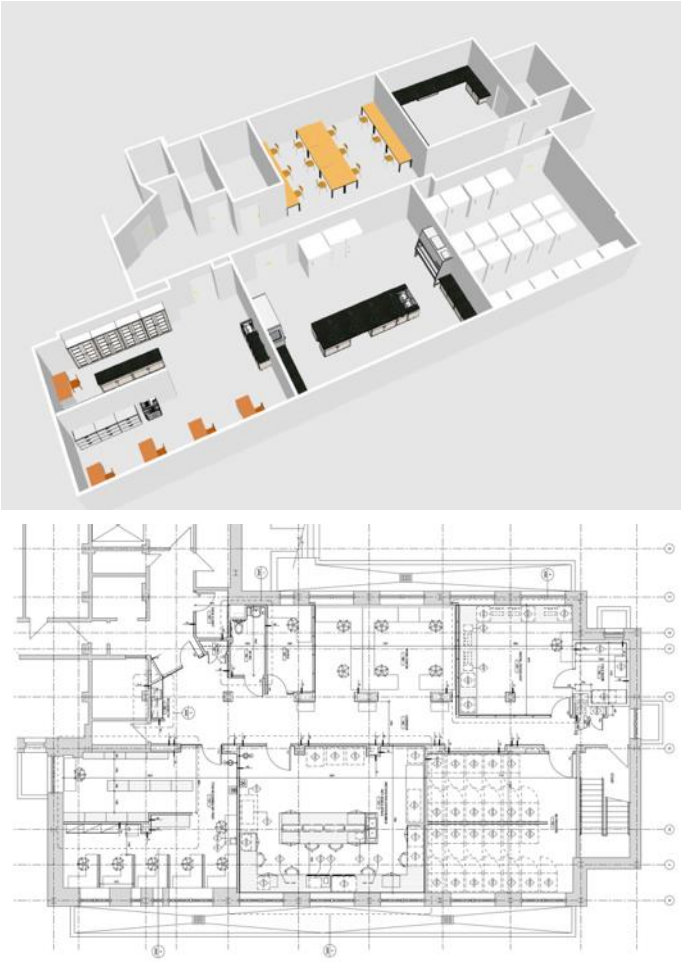
Hanna Gamelin and Kaito Lee

NEW CORE FACILITIES

CHI is developing biotechnology platforms to create a new data-driven knowledge economy that supports scale and growth for health innovation. Core facilities create vast scientific opportunities through the standardization of best practices and economies of scale. Shared platforms confer advantages through the facilitation of biotech that results in the generation of new knowledge. Physically located within KHSC, CHI platforms are specifically chosen to facilitate research where adjacency to the hospital is paramount.

Histopathology & Biobank Expansion

CHI is building a new histopathology and biobanking suite to service the research community through financial support from our partner faculties (FHS, FAS, and FEAS), the Canadian Cancer Trials Group (CTG), and the Department of Pathology. Located in Watkins 1 (the floor below the existing CHI space in KHSC - KGH site), the new suite is slated to open in December 2023 and will be the home of CTG's biobank called the Tumour Tissue and Data Repository as well as biobanks for Queen's investigators. The Queen's Laboratory for Molecular Pathology (QLMP) will be formally joining CHI and the offerings will be expanded.



Floors Plans for New Suite

Staff and faculty from the Department of Pathology, CTG, CHI, and KHSC Planning have been collaborating extensively to design the space and develop operating plans. The Histopathology Working Group meets monthly to advance strategic priorities.

Infrastructure to support the collection and storage of human specimens is fundamental to biomedical research. State-of-the-art histopathology capabilities are key to ensuring that Queen's investigators can pursue world-class biomedical research and perform clinical trials that result in evidence-based medicine.

Genomics Expansion

Harriet Feilotter and team are building a new genomics facility within CHI. Aimed at bringing whole genome and single-cell sequencing to Queen's and KHSC, the facility will be a node of the Joint Genomics Program at the Ontario Institute of Cancer Research (OICR) and University Health Network (UHN). The development of a world-class genomics facility that will service both cancer and non-cancer genomics work means that researchers, patients, and providers will have access to state-of-the-art panels and bioinformatics.

NovaSeq 6000 Installed in CHI

Funded by 1.2 million dollars from KHSC, Department of Oncology, OICR, and CTG, a NovaSeq 6000 has now been installed and will be ready for sample runs in early 2023. Our scalable approach means that users will have access to high-quality, operationalized genomics while reducing costs under our economies of scale model for core facilities.

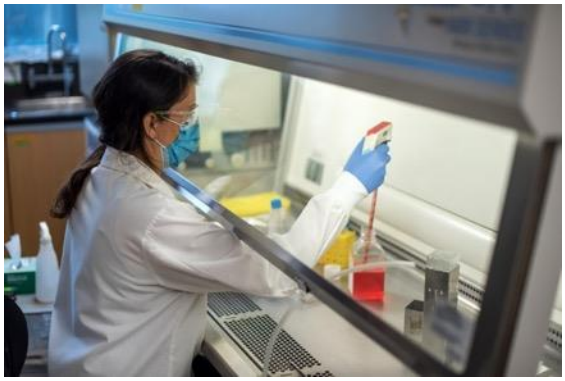
"You can't build modern clinical trial capacity without molecular selection" – Trevor Pugh, University Health Network

Mass Spectrometry

CHI is working with the Department of Chemistry, Department of Surgery, Department of Medicine, and Department of Biomedical and Molecular Sciences to build a mass spectrometry facility. The facility will work in tandem with the Department of Chemistry facility by providing services within Biosafety Level 2 to allow for the processing and analyses of human specimens. Mass spectrometry is used in a variety of applications to measure the mass-to-charge ratio of ions. Spatially resolved mass spectrometric analysis or MS Imaging (MSI) is capable of the histological and molecular classification of tissues in near real-time using the relative abundance pattern of ions corresponding to metabolites, lipids and proteins.

The facility builds upon expertise in the iKnife project (Gabor Fichtinger, Parvin Mousavi, Richard Oleschuk, John Rudan, and others) as well as other institutional strengths in mass spectrometry. CHI has to date centralized the following equipment:

- Waters Xevo TQ-S LC-MS/MS (relocated from Glen Jones lab in Department of Biomedical and Molecular Sciences)
- SCIEX TripleTOF 5600/5600+ (from Richard Oleschuk/Chemistry)
- Waters Xevo G2 XS DESI qTOF (from Gabor Fichtinger)



Laurel Ballantyne

In the coming year, CHI will work on operating models including a cost-recovery strategy consistent with the Department of Chemistry's current approach. The goal is to offer a low-cost facility with both state-of-the-art equipment and personnel support that is self-sustaining.

Bioinformatics, Data Science, and Clinical Informatics Expansion

CHI is building capacity for a variety of computational supports with appropriate privacy protections consistent with PHIPA regulations. Key highlights from this year include improvements and support for:

- **Automatic download of radiology images.** In collaboration with the Department of Radiology and the KHSC IT team, CHI has implemented automated download and anonymization of images from PACS using software provided by the Radiological Society of North America (RSNA). Historically, downloading images from PACS required a user to navigate to an image, press download, and wait minutes before downloading another image. With this new approach, CHI staff can download and anonymize hundreds of images at once that are compliant with KHSC privacy regulations while using state-of-the-art tools that generate research-ready data. As a first project, CHI-supported radiologist Johanna Ortiz is sharing hundreds of images for a crowd-sourced challenge hosted by the RSNA.
- **Bioinformatics.** Critical to the implementation of the new genomics facility is the handling and analysis of high-throughput genomic data. CHI is working with the Joint Genomics Program at the Ontario Institute of Cancer Research to implement OICR bioinformatics pipelines locally. The goal is to use these state-of-the-art tools instead of 'reinventing the wheel' to provide genomic analyses for researchers.

- **Ontario Health Data Platform (OHDP).** OHDP is a data platform provided by the Ministry of Health for research use of Ontario's health data (physically located at Queen's). OHDP was created in response to the COVID-19 pandemic to enable provincial health policy leaders to make evidence-based data-driven policy changes. CHI staff member Heather Grant provides support for OHDP-Q applications including research ethics board and TRAQ DSS submissions. We also have data science support available through CHI Data Scientist Alex Hamilton. CHI supported four projects in 2022 (Dan Borschneck, Wael Abu-Zeid, Aleksandra Zuk, Rylan Egan, and Dan Mulder).
- **Clinical informatics**. CHI is working with KHSC IT, Val Gamache-O'Leary, and the Innovation Portfolio on several projects including the virtual care and wait times initiatives. The goal is to take advantage of the new Cerner Health Information System at KHSC.

Katie Lindale, Alex Robins, Kaitlyn Kobayashi, and Ramtin Mojtahedi Saffari

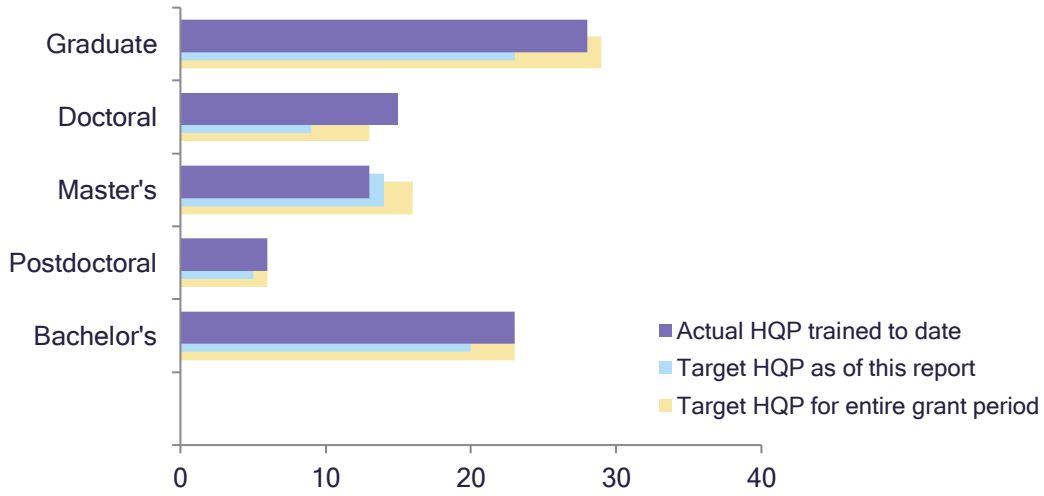
SUPPORT FOR TRAINING PROGRAMS

CHI supports the training of high-quality personnel through several programs.

NSERC CREATE Programs

CHI lends administration and other support to several NSERC (Collaborative Research and Training Experience Program) CREATE grants. CREATE programs are important to CHI because they train new researchers in important health fields. CHI is proud to support three programs:

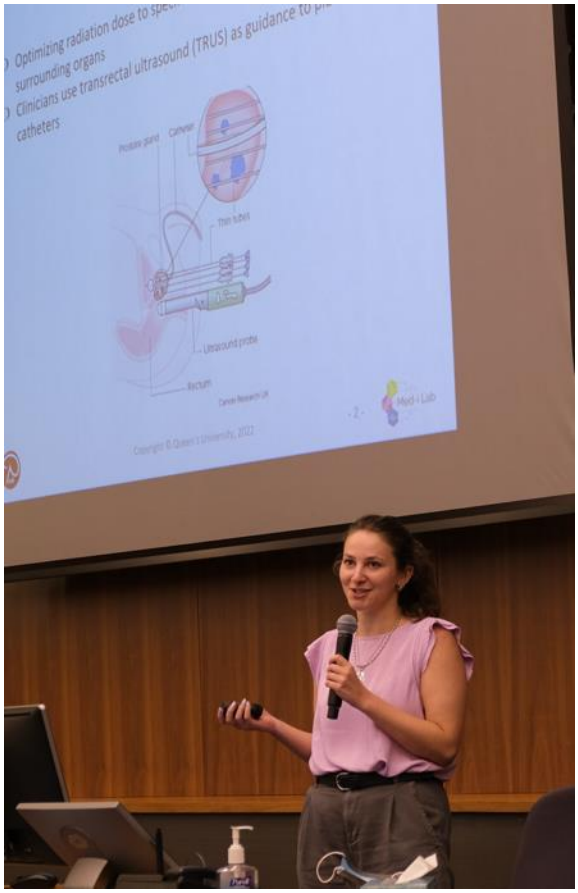
- **CONNECT** – The CONNECT Program, led by Brian Amsden, fosters future leaders with critical skills to overcome technical hurdles involved with translating treatments to the clinic. Bringing together a team of leading experts from across Canada, CONNECT's trainees hone their skills through leading-edge research projects related to technologies for ligament, articular cartilage, intervertebral disc, and adipose tissue regeneration. Over the course of the five years, fifty-seven high-quality personnel have received training and financial support from the program (see figure). Trainees have gone on to careers in cell manufacturing and tissue engineering.



HQP Trained by the CONNECT program

- **MEDi** – Led by Parvin Mousavi, the CREATE Training Program in Medical Informatics (MEDi CREATE) is aimed at preparing Canada's workforce for the health data of tomorrow by providing competency in artificial intelligence, health informatics, bioinformatics, and ethical and privacy issues. CHI provides central administrative support, space for research, and

meeting rooms for the program. MEDi CREATE students presented 3-minute pitches and posters at the CHI Symposium. Due to the pandemic, this was the first chance for many of these students to present in front of students, faculty, and staff.



Medi CREATE Student Nicole Kitner Presenting at the CHI Symposium

- **READi** – Led locally by Claire Davies, READi is unique with its multidisciplinary cohorts of students from Carleton University, University of Ottawa, and Queen's University, who retain a research focus in their home programs (e.g., engineering, information technology, design, human-computer interaction, and music), and adds theory and practice (learning by doing) in accessibility under the guidance of an interdisciplinary team. READi acknowledges the importance of affective learning (emotion/feeling), where trainees not only gain the knowledge and skills to meet accessibility needs (i.e., cognitive learning) but also develop the inspiration and motivation to do so. CHI provides research and meeting space for students in the program.

Training for Orthopaedic Surgery Residents

CHI supports the Division of Orthopaedic Surgery residents by providing the resident's library, a space for co-located work as well as access to our conference rooms for training with device manufacturers. CHI provides administrative support including access cards and room bookings. The academic teaching for the orthopedic residents consists of Trauma Rounds, Grand Rounds and an Academic Half Day each week and our staff also help residents design and execute research projects.


2022 Orthopaedic Residents

Graduate Courses

CHI provides space for specialized graduate courses that require training for specific equipment or access to clinicians. The Collaborative Biomedical Engineering Graduate Program (CBME) is one example of a multi-disciplinary graduate program at Queen's that allows students to access courses and co-supervisors across engineering departments (chemical, electrical, and mechanical) and includes courses in Anatomy, Cell Biology, and Biochemistry.

- CBME 801 Topics in Biomedical Engineering: This course covers the skills needed to plan and present Biomedical Engineering research. Topics include hypothesis and research question generation, literature reviews, statistical methods to design experiments, proposal writing, data presentation and interpretation, information design, scientific speaking and writing for presentations and publications.
- CBME 802 Biomedical Engineering Seminar Series: The objective of this course is to expose Biomedical Engineering students to the different areas of Biomedical Engineering research and practice, providing a shared learning experience to link students from each of the departments participating in the Biomedical Engineering Program. Each seminar falls into one of three categories: research, training, or clinical. Research seminars are broadly based, involving aspects of biomedical engineering, biomechanics, biomedical computing, mobility, rehabilitation and ergonomics. Training seminars cover topics of interest that would not normally be covered in course-based material, e.g. patents and intellectual property, research approaches and experimental design, effective communication of research results, and media relations. Clinical seminars cover any aspect of clinical practice that is relevant to research in the areas noted above.
- MECH829 Tissue Mechanics: Methods of characterizing biological tissues for the Mechanical Engineer with no previous biology background. The focus of this course is the histology of ligament, tendon, cartilage, and bone.

Undergraduate Courses

Select project-based undergraduate students are provided access to the centre:

- MECH 460 Team Project - Conceive and Design: Students working in teams are required to "conceive and design" a product, system or process using the knowledge and skills acquired in earlier courses. Elements of the design include: specification of function, analysis, selection of materials and/or components, preparation of working drawings, cost analysis and tenders, and preparation of a preliminary design report.

- MECH462 Team Project - Implement and Operate: The elective course MECH462 enables team projects there were designed in MECH460 to continue through the implementation and operational phases of the design cycle. An engineering design report is prepared and defended, supported by a working prototype, physical mock-up, or virtual model. Testing a process or system may replace the building of a prototype.
- Capstone Projects - Examples of Capstone Projects are the design of a pediatric prosthetic foot (Bryant) and the design of a surgical biopsy device (Purzner).

Laurel Ballantyne and Lindsay Fitzpatrick

OUTREACH

CHI provides space and administrative support to a variety of outreach activities.

Chair in Women and Engineering

CHI was a key supporter of the Queen's University Women in Engineering Program (WiE). CHI provides the Women in Engineering Program with a physical space to work and administrative support. Having access to CHI's space allows WiE to have a centralized workspace for offices, meetings, and day-to-day operations.

Many of the Centre's researchers and students volunteered at or participated in WiE initiatives and events. In both July and August, CHI labs volunteered at WiE's fun, hands-on workshops as part of Connections Engineering Outreach's summer camps. The Centre's Regenerative Engineering Laboratory taught girls in grades 3-4 about the properties and various applications of hydrogels by making slime. In concurrent sessions, The Bone and Joint Biomechanics Lab challenged students in grades 7-11 with improving the classic arm cast and building a prototype while following the engineering design process. Researchers also volunteered at GoEngGirl, where WiE hosted 130 girls in grades 7-11 in a fun Chindōgu design workshop! Groups were very creative in coming up with and building their designs, sharing lots of laughs throughout the process.

GoEngGirl Workshop (left) and International Women in Engineering Day (right)

CHI researchers also attended the annual International Women in Engineering Day celebration, hosted by WiE. The luncheon was open to women and allies at all levels, aimed at celebrating WiE at Queen's 2022 achievements, both big and small. Several women from CHI had their achievement(s) from the year highlighted in the event booklet/handouts/material.

Alejandra Correa Belloso Working in the Bone and Joint Biomechanics Lab

QBiT

The Queen's Biomedical Innovation Team (QBiT) (Claire Davies, faculty advisor) aims to introduce undergraduate students from a variety of disciplines to biomedical engineering by exploring practical applications of the engineering curriculum, and by promoting interdisciplinary collaboration to solve common problems within the field of medicine. QBiT strives to develop projects spanning multiple areas of biomedical technology using cutting-edge mechanical, electrical, and biochemical systems to design and manufacture physical solutions.

Noah and Darien from QBiT in CHI

Project 1: Fall Detecting Inflatable Helmet: Trail running is a popular recreational activity, but participants are at risk of falls and serious head injuries. With trail runner safety and comfort in mind, QBiT will be designing a fall-detecting inflatable helmet. The helmet will use various sensors to detect

a fall and will inflate instantaneously after fall detection to protect the wearer from injury. Similar technology has already been implemented into official MotoGP protective racing suits, so QBiT believes that the next logical step is developing protective headwear with inflation-based protection. This device looks to offer superior fall protection to trail runners while offering a slimmer and lighter profile, redefining a helmet's role for running enthusiasts.

Project 2: Artificial Lung: The COVID-19 pandemic has highlighted both the value and scarcity of respiration devices for treating respiratory illnesses in medical emergencies. With the Artificial Lung project, QBiT looks to develop a prototype that can perform oxygenation and CO_2 scrubbing on blood and blood substitutes. The device's design will be small and portable, allowing potential use in EMS vehicles or remote locations. Due to the sterile conditions required in blood transfer devices, ease of sterilization will also be considered by designing tubing and other parts that will be replaceable or easy to clean. The device will sustain basic lung functions for a finite period at physiological conditions until the patient can be moved to a more stable location with long-term respiration aids, such as an ECMO or another medical equivalent.

CHI is pleased to provide meeting rooms, rapid prototyping, mentorship and storage space to QBiT.

MEET THE STAFF

Heather Grant, Clinical Research Facilitator: Heather holds a Master's degree in Community Health and Epidemiology from Queen's University. She assists academics, clinicians, and students to accomplish their research goals. Heather provides guidance on study design and statistical methodology, helps write scientific papers, research protocols and reports, presentations, and conference abstracts, performs data analyses and prepares the results for presentations and publications. In addition, she oversees the ethical compliance of the Centres' research projects though the submission, amendment and renewal of documents required by the Queen's University Health Sciences and Affiliated Teaching Hospitals Research Ethics Board, Clinical Trials Ontario and the Ontario Cancer Research Ethics Board. This involves correspondence with representatives from other academic and clinical institutions, funding agencies and industry sponsors to manage and expedite project milestones. Heather recently received a Graduate Diploma from the Queen's School of Rehabilitation Aging and Health Program with a focus on advanced statistical analyses, qualitative research methodology and the bioethics of aging.

Alex Hamilton, Data Scientist: Alex is a Registered Nurse and graduate of the MSc (Nursing) and Master of Biomedical Informatics (MBI) programs at Queen's University. Prior to joining Centre for Health Innovation he worked in a variety of clinical roles, namely as staff nurse and cardiac care coordinator in the KHSC Intensive Care Unit and cardiac programs. Prior to his role at Centre for Health Innovation, he worked to develop deep learning algorithms for automated atrial fibrillation detection in KHSC ICU (Conduit Lab - Dr. David Maslove) and explored the feasibility of machine learning guided prostate cancer detection with high-frequency transrectal ultrasonography (Med-i Lab - Dr. Parvin Mousavi).

At CHI, he uses machine learning and other computational techniques to support a variety of research and quality improvement projects across Queen's Faculty of Health Sciences and the Department of Medicine. He is also the primary data scientist for the KHSC Innovation Portfolio.

Alex is passionate about nursing and the use of advanced analytics for improving outcomes across all healthcare sectors. A more recent partnership with KFL&A Public Health has allowed him to explore a variety of natural language processing methods for improving

opioid overdose and mental health crisis detection within the Acute Care Enhanced Surveillance tool. He enjoys learning new technologies and pushing the boundaries on what can be expected from clinicians in these highly technical applications.

Fiona Howells, Clinical Research Associate: Fiona has a UK Pharmacy degree and over 10 years of experience as a clinical research coordinator in Canada. Fiona specializes in patient recruitment and follow-up, together with maintaining the regulatory documents required for both local and multi-centre trials. Fiona loves living and working in Kingston and enjoys exploring all that Canada has to offer.

Leone Ploeg, Research Engineer: Leone completed her Bachelor's in Mechanical Engineering at the University of Ottawa and her Master's at the University of Calgary in Computer Modelling Applied to Gait of Below-Knee-Amputee and Able-Bodied Children. Before coming to Queen's, she worked at the World Heart Corporation, a medical devices company focused on the development of a fully implantable heart assist device. She joined Queen's in 2002 at the then called, Human Mobility Research Centre as a Research Engineer. In 2006 her role was expanded to include more of the day-to-day running of the Centre.

Joan Willison, Receptionist: Joan Willison is the welcoming face that greets everyone to CHI. Previously, Joan worked for the Whig Standard as Secretary to the Publisher. Much of her time was spent organizing community events including the KGH Black Tie Gala. She also sat on the Board of Martha's Table. Joan started at Queen's in 2007 and continues in her current role assisting staff and students and conducting various administrative duties.

FINANCIAL STATEMENT

Statement of Financial Position

- $46.5M in total research revenue has been secured by faculty associated with CHI since 2016 but under the Queen's budget model, overheads flow to Departments and Faculties, not research centres.
- CHI therefore relies on funding from the faculties to offset operational costs.
- In 2022/2023, the Faculty of Engineering and Applied Science, Faculty of Arts & Science, Faculty of Health Sciences, and the Department of Surgery provided $100,000 each as part of a joint agreement for Dr. Simpson's directorship.
- A Memo of Understanding (MOU) is needed between the hospital and the university to define the flow of overheads to the centre.
- CHI is working to create a pay-per-service model that enables the centre to support infrastructure enhancements, which has generated a budget surplus that will be invested back into the centre.

	Item	May 2021-April 2022	May 2022 - April 2023
Revenue			
	Carry Forward	2,918	24,932
	Research Projects/Cost Recovery	130,972	338,118
	Faculties/Surgery/VPR	425,000	453,000
	Total Revenue	**558,890**	**816,050**
Expenses			
	Salaries and Benefits	483,770	523,573
	Non-Salary Expenses	50,188	51,045
	Total Expenses	**533,958**	**574,618**
Surplus (deficit)		**24,932**	**241,432**

APPENDIX 1: THE EVOLUTION OF HMRC – THE CENTRE FOR HEALTH INNOVATION

The Centre for Health Innovation has a long history which began in 1968 when Charles Sorbie, the Head of Orthopaedic Surgery, recognized the need for a Bioengineer to implement current engineering expertise into orthopaedic and other surgical practices. Philip Lowe took on that role when he was appointed to the Division of Orthopaedics and the Biomedical Electronics Unit (which later became the Biomedical Engineering Unit), headed by Denis Lywood. Coinciding with this event was for the formation of the Rheumatic Diseases Unit within the Department of Medicine. These developments led to the inception of The Clinical Mechanics Group (CMG) which gained an international reputation for its research contributions in orthopaedic biomechanics throughout the 1970s.

The CMG grew and was granted official university status in 1984. It's founding researchers included Drs. Charles Sorbie and Derek Cooke (Department of Surgery, Division of Orthopaedics), Henk Wevers (Department of Mechanical Engineering) and Judy Durance (Department of Physical Medicine). In 1987, the CMG moved to the newly established Apps Medical Research Centre in Kingston General Hospital. The group grew to ten faculty members over the next decade and was funded in part by NSERC and MRC Grants.

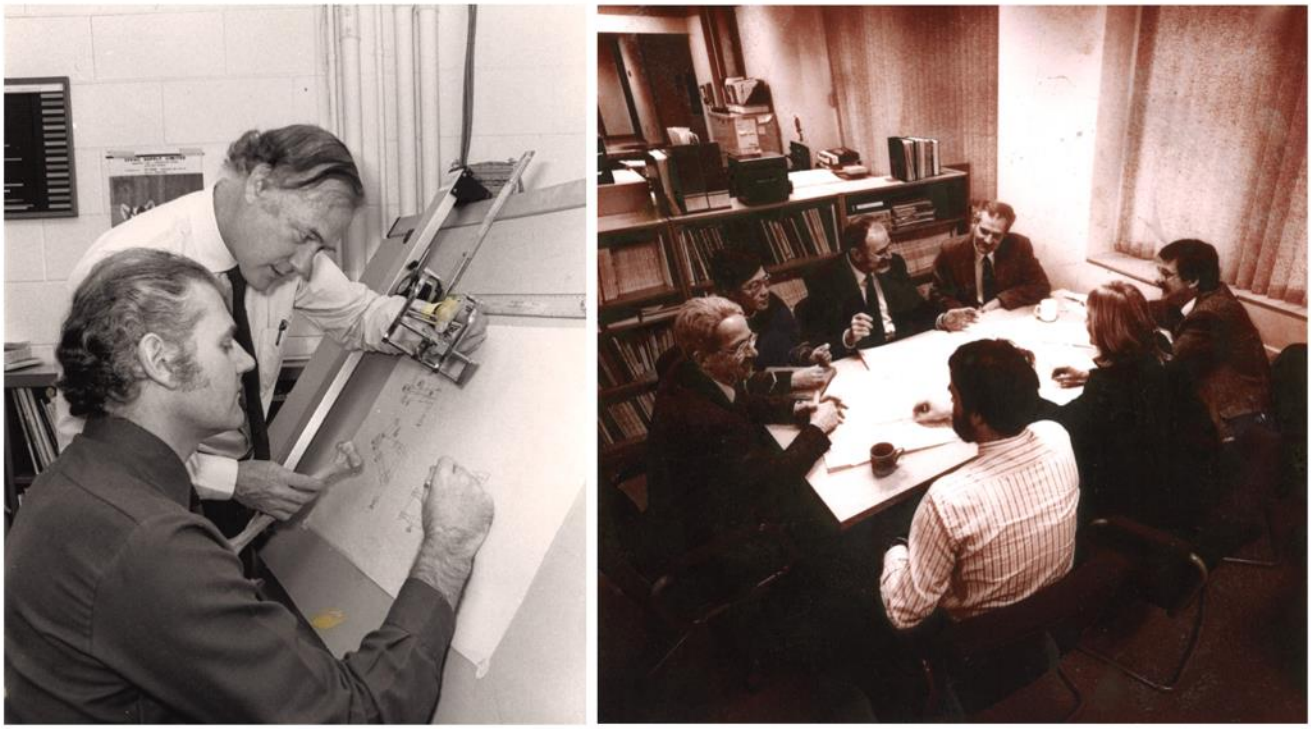
Over time, with ongoing advances in musculoskeletal treatments integrating mechanical design, emergent biological techniques in regenerative medicine, information technologies and rehabilitation therapies, the group evolved to include researchers from a broader representation of disciplines interested in musculoskeletal research. These included biochemistry, chemical engineering, clinical psychology, computing science and information technologies, epidemiology, immunology, kinesiology, and rehabilitation therapy. Subsequent infrastructure resources were obtained to support this growth, and in 2002 the CMG became the Human Mobility Research Center (HMRC).

The HMRC was a collaborative model governed by Queen's and Kingston General Hospital, with representation from the Faculties of Engineering and Applied Science, Health Sciences, and Arts and Science. The mission of the Centre was to help people live fuller, more mobile lives through the development of innovative and effective treatment strategies for bone and joint disorders caused by arthritis, osteoporosis, injury, and related problems.

After two decades of continuing to grow and foster collaborative research, the HMRC was in the position to leverage its unique interdisciplinary strengths to address the increasing

complexity of today's health and healthcare delivery challenges. In response, the HMRC once again evolved to become the Centre for Health Innovation (CHI).

The CHI will provide a multifaceted, radically interdisciplinary environment where numerous solutions-focused groups including clinician-scientists, basic scientists, social scientists, engineers, and humanities experts collaborate to tackle healthcare problems. By integrating insights from the frontlines of care to understand real-world experiences, the needs of patients and healthcare professionals, CHI will build an innovation platform that harnesses best-in-class health data to generate hypotheses, fuel understandings and monitor impacts. By engaging inspired investigators from multiple disciplines, who understand the creative and innovative power of inclusion, CHI will forge a path to the next generation of health solutions that will redefine better health for all.



(Left) Charles Sorbie and Gerald Saunders Working on the Sorbie-Questor Total Elbow System and (Right) Henk Wevers, David Siu, Derek Cooke, Gerald Saunders, Tim Bryant, Sandra Olney, Urs Wyss in the Clinical Mechanics Group

APPENDIX 2: SYMPOSIUM PROGRAM

Program Overview

Talks will be broadcast via Zoom

Day 1 — June 6th, 2022

8:30 – 8:45	**Indigenous Elders Welcome** Clinton Doxtator	Lecture Theatre (Room 132A)
8:45 – 9:00	**Opening Remarks** Elizabeth Eisenhauer, Amber Simpson	Lecture Theatre (Room 132A)
9:00 – 10:50	**Session 1: Biobanking** Chairs: Michael Rauh, Eva Slotman	Lecture Theatre (Room 132A)
10:50 – 11:00	**Break**	Atrium
11:00 – 12:50	**Session 2: From Cells to Communities** Chairs: Maria Aristizabal, Roshni Rainbow	Lecture Theatre (Room 132A)
12:50 – 1:30	**Boxed Lunch** (for in-person attendees)	Atrium
1:30 – 3:05	**Session 3: Better Living Through Chemistry** Chairs: Lindsay Fitzpatrick, Yuxi Zhang ***Including Keynote Presentation:*** *Carbon-to-metal Coating Institute: Navigating the grant process* Chantelle Capicciotti, Cathleen Crudden	Lecture Theatre (Room 132A)
3:05 – 3:45	**Poster Session 1 & Demos**	Grand Corridor/ Demo Rooms TBA
3:45 – 4:30	**Panel Session:** *Medical device design and use: what does sex have to do with it?* Katrina Gee, Susan Phillips, Laura Wells	Lecture Theatre (Room 132A)

Day 2 — June 7th, 2022

8:30 – 8:35	**Opening Remarks** Elizabeth Eisenhauer, Amber Simpson	Lecture Theatre (Room 132A)
8:35 – 11:15	**Session 4: Global Health in Local Health** Chairs: Shaila Merchant, Colton Barr	Lecture Theatre (Room 132A)
11:15 – 12:00	**Poster Session 2**	Grand Corridor
12:00 – 1:00	**Boxed Lunch** (for in-person attendees)	Atrium
1:00 – 2:50	**Session 5: Staying Healthy** Chairs: Megan Carter, Alexandra Robins	Lecture Theatre (Room 132A)
2:50 – 3:05	**Break**	Atrium
3:05 – 3:50	**Panel Session:** Chair: Jordan Loewen *How, Why, Should We Digital Twin? The implications of new AI technologies for medicine health, and well-being* Sharday Mosurinjohn, Amber Simpson	Lecture Theatre (Room 132A)
3:50 – 5:10	**Session 6: Informatics** Chairs: Megan Bailey, Jessica Rodgers	Lecture Theatre (Room 132A)
5:10 – 5:30	**Awards Session & Concluding Remarks** Elizabeth Eisenhauer, Amber Simpson	Lecture Theatre (Room 132A)

Queen's University

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Session 1: Biobanking

Lecture Theatre (Room 132A)
Talks will be broadcast via Zoom
Chairs: Michael Rauh, Eva Slotman

9:00 – 9:05	**Announcement:** Biobanking Expansion Annette Hay, Amber Simpson
	15-minute talks + 5 minutes for Q&A
9:05 – 9:20	**ExCELLirate Canada: Pioneering cell therapy research together** Annette Hay, on behalf of the ExCELLirate Team
9:30 – 9:45	**The fundamental role of biobanking in establishing an academic clinical practice and translational research program** Holly Mewhort, James Purzner, Teresa Purzner
9:55 – 10:10	**Queen's Pathology and Canadian Cancer Trials Biobank** Shakeel Virk
10:20 – 10:35	**Blood cancer surveillance and precision medicine facilitated by biobanks** Sheela Abraham, Michael Rauh
	NSERC CREATE in Medical Informatics Pitches
10:45 – 10:50	**Distinguishing radionecrosis from recurrent glioblastoma using rapid evaporative ionization mass spectrometry** Dilakshan Srikanthan

Session 2: From Cells to Communities

Lecture Theatre (Room 132A)
Talks will be broadcast via Zoom
Chairs: Maria Aristizabal, Roshni Rainbow

11:00 – 11:05	**Announcement:** Genomics Expansion Harriet Feilotter, Prameet Sheth, Amber Simpson
	15-minute talks + 5 minutes for Q&A
11:05 – 11:20	**Translational genomics at Queen's and KHSC** Nicole Archer, Scott Davey, Harriet Feilotter, Hamid Ghaedi, Stephanie McCormack, Laura Semenuk, Amber Simpson, Nick Zhang
11:30 – 11:45	**Successes from COVID-19** Prameet Sheth
11:55 – 12:10	**Neuro-immune interactions in health and disease** Qingling Duan, Nader Ghasemlou, Sebastien Talbot
12:20 – 12:35	**Convergence research for tick-borne diseases** Rob Colautti, Qingling Duan, Rylan Egan, Nader Ghasemlou, Tim Salomons
	NSERC CREATE in Medical Informatics Pitches
12:45 – 12:50	**Feature selection for polygenic risk scores using genetic algorithm** Zhendong Sha

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Session 3: Better Living Through Chemistry

Lecture Theatre (Room 132A)
Talks will be broadcast via Zoom
Chairs: Lindsay Fitzpatrick, Yuxi Zhang

15-minute talks + 5 minutes for Q&A	
1:30 – 1:45	**Doctor, did you get it all? Am I going to be OK?** Joanna Cheesman, Alessia Di Carlo, Joshua Ehrlich, C. Jay Engel, Gabor Fichtinger, Amoon Jamzad, Martin Kaufmann, Kathryn Logan, Shaila Merchant, Parvin Mousavi, Richard Oleschuk, Kevin Yi Mi Ren, Jessica Rodgers, John Rudan, Tamas Ungi, Sonal Varma, Ross Walker, Julie Wallis
1:55 – 2:10	**Rapid Tissue and Pathogen Profiling Using Patterned Materials and Open Port Interface** Richard Oleschuk
NSERC CREATE in Medical Informatics Pitches	
2:20 – 2:25	**Robotic tumor-bed inspection in breast conserving surgery** Laura Connolly
2:25 – 2:30	**Automated tumour reconstruction for real-time visualization in breast-conserving surgical navigation** Chris Yeung
2:30 – 2:35	**Finding patterns in mass spectrometry images** Rachel Theriault
Keynote	
2:35 – 3:05	**Carbon-to-metal Coating Institute: Navigating the grant process** Chantelle Capicciotti, Cathy Crudden

Poster Session 1

Grand Corridor
Vote for the Audience Choice Poster Award using the stickers provided!

1	**Dilakshan Srikanthan**	Distinguishing radionecrosis from recurrent glioblastoma using rapid evaporative ionization mass spectrometry
2	**Zhendong Sha**	Feature selection for polygenic risk scores using genetic algorithm
3	**Laura Connolly**	Robotic tumor-bed inspection in breast conserving surgery
4	**Chris Yeung**	Automated tumour reconstruction for real-time visualization in breast-conserving surgical navigation
5	**Rachel Theriault**	Finding patterns in mass spectrometry images
6	**Mahsa Zojaji**	Quantifying the contribution of dietary mineral intake to cortical bone mechanical properties under compressive loading using finite element analysis
7	**Courtney Bannerman**	TBD
8	**Angela Choi**	Investigating biomarkers to improve prediction of response to anti-PD-1 therapy in non-small cell lung carcinoma
9	**Sumaiya Karim**	Responsive surface modifications of acrylic-based copolymers for the modulation of lens epithelial cell behaviour
10	**Eva Slotman**	Nuclear morphometry as a tool for refining diagnostic categories in bladder cancer pathology

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Session 4: Global Health is Local Health

Lecture Theatre (Room 132A)
Talks will be broadcast via Zoom
Chairs: Shaila Merchant, Colton Barr

15-minute talks + 5 minutes for Q&A	
8:35 – 8:50	**Virtual Simulations for Global Health Equity** Marian Luctkar-Flude, Kevin Woo
9:00 – 9:15	**A program of cervical cancer prevention in low-resource settings through the power of DNA testing, cervical imaging, histopathology and smartphones** Melinda Chelva, Karen Yeates
9:25 – 9:40	**Utility of Point of Care Portable MRI for Cerebral Imaging in a Remote Northern Canadian Health Authority** Gord Boyd, Chloe DesRoche, Elaine Innes, Omar Islam, Ben Kwan, Johanna Ortiz-Jimenez, Ian Silver, Donatella Tampieri, KHSC IT Team, WAHA Family Physicians
9:50 – 10:05	**Ergonomic analysis and design for improved health of Faso DanFani weavers in Burkina Faso** Samuel Brost, J. Timothy Bryant, Charlie Drysdale, Genevieve Dumas, Qingguo Li, Amidou Sawadogo
10:15 – 10:30	**CareCo** Nicole Bobbette, Afolasade Fakolade
10:40 – 10:55	**To participate, you must be able to communicate** Beata Batorowicz, Claire Davies
NSERC CREATE in Medical Informatics Pitches	
11:05 – 11:10	**Low cost prostate capsule reconstruction using optical tracking and deep learning** Colton Barr
11:10 – 11:15	**A 3D US percutaneous liver ablation system for ultrasonically invisible tumors** Shuwei Xing

Poster Session 2

Grand Corridor
Vote for the Audience Choice Poster Award using the stickers provided!

1	**Colton Barr**	Low cost prostate capsule reconstruction using optical tracking and deep learning
2	**Kenna Bartlett**	Predictive model from factorial analysis of factors affecting glenoid baseplate micromotion in reverse shoulder arthroplasty
3	**Mahdi Gilany**	Towards confident detection of prostate cancer using high resolution micro-ultrasound
4	**Nicole Kitner**	Automatic catheter modelling in 3D transrectal ultrasound images from high-dose-rate prostate brachytherapy using deep learning and feature extraction methods
5	**Yuxi Zhang**	Effects of exogenous insulin on macrophage survival and pre-inflammatory signalling
6	**Nadejda Boev**	Whole genome sequencing (WGS) enhances and refines institutional responses to SARS-CoV-2
7	**Kyla Tozer**	TBD
8	**Melinda Chelva**	Assessing the implementation of patient navigation delivery strategies to the smartphone-enhanced Cervical Cancer Prevention Program in Tanzania
9	**Paola Dantonio**	Embryonic protein NODAL plays anti-tumourigenic roles in thyroid cancer
10	**Hailey Gowdy**	The DouleurCircaPain study: examining circadian control of chronic pain through a national cross-sectional survey
11	**Ramtin Mojtahedi Saffari**	Tumor segmentation in colorectal liver metastasis using an optimal vision transformer patch resolution

Session 5: Staying Healthy

Lecture Theatre (Room 132A)
Talks will be broadcast via Zoom
Chairs: Megan Carter, Alexandra Robins

15-minute talks + 5 minutes for Q&A	
1:00 – 1:15	**Dietary phosphate as a sex-specific mediator of bone loss in spaceflight** Michael Adams, Susan Bloomfield, Rachel Holden, Austin Lansing, Brent Lievers, Keith Pilkey, Heidi-Lynn Ploeg, Tyler Rowsell, Scott Smith, Mandy Turner, Mahsa Zojaji, Sara Zwart
1:25 – 1:40	**Revved up program** Amy Latimer-Cheung, Jennifer Tomasone
1:50 – 2:05	**Investigating form and function relationships in orthopaedic biomechanics** Ryan Bicknell, Dan Borschneck, Parham Daneshvar, Erin Lee, Zoe Mack, David Pichora, Michael Rainbow, Lauren Welte, Mitchell Wheatley
2:15 – 2:30	**Monitoring wastewater for COVID-19 prevalence** Dwayne Francis, Sarah Jane Payne, Nancy Slipp
NSERC CREATE in Medical Informatics Pitches	
2:40 – 2:45	**Testing and validation of total joint replacements** Kenna Bartlett
2:45 – 2:50	**Radiomic analysis of bone metastases to predict clinical outcomes following SBRT** Lauren Zelko

Session 6: Informatics

Lecture Theatre (Room 132A)
Talks will be broadcast via Zoom
Chairs: Megan Bailey, Jessica Rodgers

15-minute talks + 5 minutes for Q&A	
3:50 – 4:05	**Characterizing the impact of virtual care and the COVID-19 pandemic on capacity of ambulatory clinical care at Kingston Health Sciences Centre** Elizabeth Eisenhauer, Alex Hamilton
4:15 – 4:30	**The living lab** Tara Baetz
4:40 – 4:55	**Opportunities in the Queen's health data landscape** Amber Simpson
NSERC CREATE in Medical Informatics Pitches	
4:55 – 5:00	**Towards confident detection of prostate cancer using high resolution micro-ultrasound** Mahdi Gilany
5:00 – 5:05	**Automatic catheter modelling in 3D transrectal ultrasound images from high-dose-rate prostate brachytherapy using deep learning and feature extraction methods** Nicole Kitner
5:05 – 5:10	**Biomedical data mining using evolutionary learning algorithm** Chengyuan Sha

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APPENDIX 3: TRIALS

PI	Unit	Study
Abraham	FHS-DBMS	A biomechanical assessment of the Exeter short revision stem as a primary total hip arthroplasty system
Bardana	FHS – Ortho	Stability II
Bardana	FHS – Ortho	Novacart
Bardana	FHS – Ortho	Stability
Bardana	FHS – Ortho	STABLE
Bicknell	FHS – Ortho	SIDUS II
Bicknell	FHS – Ortho	Servasa >15
Bicknell	FHS – Ortho	Global Icon
Bicknell	FHS – Ortho	Servasa <15
Bicknell	FHS – Ortho	Nano
Bicknell	FHS – Ortho	COPE
Bicknell	FHS – Ortho	PITSA
Borschneck	FHS – Ortho	SQUASH
Borschneck	FHS – Ortho	PREVIEW
Daneshvar	FHS – Ortho	Acumed
Islam/Simpson	FHS	Canon
Mann	FHS – Ortho	EPCAT III
Mann	FHS – Ortho	FLIP
Patel	FHS – Surgery	Early Closure
Rudan	FHS – Ortho	iGuide
Rudan	FHS – Ortho	Ceramax
Rudan	FHS – Ortho	iKnife
Rudan	FHS – Ortho	Breast Lumpectomy with IKnife
Rudan/Kaufmann	FHS – Ortho	PCORI Vitamin D
Simpson/Purzner/ Siemens	FHS	TFRI Marathon of Hope
Wood	FHS – Ortho	HIP ATTACK
Wood	FHS – Ortho	Bilateral Knee Study
Yach	FHS – Ortho	Vancouver
Yach	FHS – Ortho	Periprosthetic distal femur
Yacob	FHS – Surgery	Comparing Prevena Incisional Management System to Standard Therapy
Zevin	FHS – Surgery	Brave
Zevin	FHS – Surgery	COR Weight Maintenance Study
Zevin	FHS – Surgery	COR Weight Regain Study

APPENDIX 4: PROJECTS

PI	Unit	Study
Amsden	FEAS	CONNECT! NSERC CREATE Program In Soft Connective Tissue Regeneration/Therapy
Bicknell	FHS – Ortho	Development of a cadaveric shoulder kinematic simulator
Bicknell	FHS – Ortho	Micromotion Measurement for Reverse Shoulder Arthroplasty: A Cadaver Study.
Bin Dous/Alkhateeb	FHS – Surgery	3D Printed Patient-Specific Femoral Drill Guide for Medial Patellofemoral Reconstruction
Bisleri	FHS – Surgery	SURG-484-19 Mitral valve data registry
Bisleri	FHS – Surgery	SURG-474-19 Endocarditis Outcomes in Cardiac Surgery
Bisleri	FHS – Surgery	SURG-400-17 Endoscopic Vessel Harvesting
Bisleri	FHS – Surgery	Morphological Analysis of Atrioventricular Valves in Fresh-Frozen and Embalmed Cadaveric Heart Specimens.
Borschneck	FHS – Ortho	SURG-510-20: Soft-tissue Quadriceps autograft ACL-reconstruction in the Skeletally-immature vs. Hamstrings (SQuASH)
Borschneck	FHS – Ortho	SURG-493-19 Prospective Evaluation of Sport Activity and the Development of Femoroacetabular Impingement in the Adolescent Hip (PREVIEW)
Borschneck	FHS – Ortho	SURG-438-18 Prospective Evaluation of Sports Activity and the Development of Femoroacetabular Impingement in the Paediatric Hip (PREVIEW): A Feasibility Study.
Borschneck	FHS – Ortho	SURG-366-16 Minimally Invasive Computer-assisted Orthopaedic Spine Research: a cadaver study.
Bryant	FEAS	Improved friction and wear performance in polymeric components of orthopaedic bearings.
Bryant	FEAS	Niagara Foot
Carter	KFL&A Public Health	EPID-747-22: Improving flexibility and performance of the Acute Care Enhanced Surveillance (ACES) System for public health surveillance: an ensemble of state-of-the-art machine learning and rule-based natural language processing methods
Carter, Hastings-Truelove	KFL&A Public Health	EPID-725-21: Using Machine Learning Methods and Twitter to Monitor COVID-19 Vaccination Sentiment in Southeastern Ontario
Cottrell	FHS	CFI
Cottrell	CHI Infrastructure	Infrastructure planning to support digital pathology
Daneshvar	FHS – Ortho	SURG-550-21 Chronic Mallet Finger Splint Study
Daneshvar	FHS – Ortho	SURG-544-21: A randomized controlled trial assessing triceps strength following olecranon fracture fixation using a triceps tendon sparing plate vs triceps tendon split plate
Daneshvar	FHS – Ortho	SURG-536-21: A pilot study to assess supination torque following onlay versus inlay two incision repair of acute distal biceps tendon ruptures.

Daneshvar	FHS – Ortho	SURG-535-20: Database of clinical and radiographic follow ups in patients receiving surgery for an upper extremity disorder.
Daneshvar	FHS – Ortho	SURG-530-20: Cadaveric study of the elbow, hand and wrist. Posterior interosseous nerve (PIN) location in relation to three common approaches of the elbow.
Daneshvar	FHS – Ortho	SURG-523-20: Proximal Ulna Osteotomy: Examining Patient Outcomes Using a Novel Osteotomy in complex distal humerus fractures
Daneshvar	FHS – Ortho	Perilunate Injuries – Long Term Follow-Up of Outcomes
Davies	FEAS	Increasing Independence through access to technology
Davies	FEAS	Building and Designing Assistive Technology
Deluzio	FEAS	MECH-075-21 Markerless motion capture for the assessment of human movement in orthopaedic populations and asymptomatic individuals
Deluzio	FEAS	MECH-046-13 Measuring Biomechanic Joint Motion
Deluzio	FEAS	Development of a Large-Scale Database of Human Motion in Out of Laboratory Environments using Markerless Motion Capture.
Egan	FHS	Using Artificial Intelligence to Investigate the Impacts of marginalization on COVID-19 mortality and morbidity.
Eisenhauer	KHSC Innovation Portfolio	eReferral – Novari
Eisenhauer and Albrough	KHSC Innovation Portfolio	Designing and Piloting Modern Data Infrastructure at KHSC
Eisenhauer and Hay	KHSC Innovation Portfolio	Using NLP and other Machine Learning Document Question Answering Techniques for Hematology Referral Triage
Eisenhauer, Appiready, Digby, and Ynoe de Moraes	KHSC Innovation Portfolio	Eliminating Wait Times – eVisits Evaluation
Eisenhauer, Chaplin, McIntosh, and Hann	KHSC Innovation Portfolio	Emergency Department transfers from LTC and Retirement Residences
Eisenhauer, Donnelly and Srivastava	KHSC Innovation Portfolio	Eliminating Wait Times – request (Evaluation + Dashboards)
Eisenhauer, Hay, Houlden, Kelley, and Reid	KHSC Innovation Portfolio	Eliminating Wait Times – Primary Care Pathways Evaluation
Engel	FHS – Surgery	Computer-Assisted Breast Conserving Surgery - Proof of Concept Study on Non Palpable Tumors
Feilotter	CHI Infrastructure	Pipeline development and infrastructure planning to support whole genome sequencing (NovaSeq)
Fichtinger	FAS	Needle Guidance in soft tissue
Fichtinger	FAS	Improvement of Image-guided Procedure Training by Using Augmented Reality Visualization.
Hay	FHS	ExCELLirate Canada
Hendry	FHS – Ortho	Characterizing the prevalence of electrodiagnostic abnormality in pronator quadratus associated with ulnar compression neuropathy at the elbow.
Hendry	FHS – Ortho	Improving Outcomes in Peripheral Nerve Surgery

Holden	FHS	Dietary Phosphate as a Sex-specific Mediator of Bone Loss in Spaceflight
Islam	CHI Infrastructure	Infrastructure planning to support bulk data extraction from PACS to support research priorities in the Department of Radiology
Li	FEAS	Study and Prevention of Musculo-skeletal Problems in Traditional Weavers in Burkina Faso: A Multinational Biomechanical and Ergonomics Research Collaboration between Canada, China, Burkina Faso and Benin
Li	FEAS	Load Carriage Tools for Testing Military Soldier Systems
Mann	FHS – Ortho	SURG-522-20: Examining the influence of surgical approach preference when treating displaced femoral neck fragility fractures.
Mann	FHS – Ortho	SURG-455-18 Exploring the Impact of Fluoroscopy for Forearm Fracture Reduction on Patient Safety: A Quality Assessment Project
Mann	FHS – Ortho	Patient adoption of a nutrition supplement program in the perioperative period of arthroplasty in an Ontario hospital system.
Martou	FHS – Surgery	SURG-475-19 Use of optical surface scanning for surgical planning and evaluation in patients undergoing balancing reconstructive surgery for breast deformities
Martou	FHS – Surgery	Assessment of 3D Surface Scan for Breast Volume Measurement
Maslove	FHS	K2ICU Data Management
Maslove et al	FHS	KHSC ICU Waveform and Vital Sign Data Conversion and Archival for Machine Learning Applications in Department of Critical Care Medicine
McKay	FHS – Surgery	Intraoperative Margin Assessment During Basel Cell Carcinoma Excision Using Mass Spectometry in Real Time.
Mousavi	FAS	NSERC CREATE Training Program in Medical Informatics: Preparing Canada's Workforce for Health Data of Tomorrow
Mousavi	FAS	SCOMP-003-07 Ultrasound-Guided Percutaneous Pain Management
Mousavi	FAS	Tissue identification using the iKnife for REIMS mass spectrometric analysis in neurosurgery.
Mulder	FHS	Improving pediatric urgent care flow through implementation of an interactive website: “Choosing the Best Urgent Care Location for your Child”
Mulder	FHS	PAED-541-22: Leukocyte perturbations in response to COVID-19 in inflammatory bowel disease patients: understanding immune protection in a highly susceptible population
Mulder	FHS	The connection between “pediatric acute hepatitis of unknown origin” and regional incidence of COVID-19.
Ortiz Jimenez	FHS	The Detection of Cervical Spine Fractures - RSNA-AI Machine Learning Challenge
Pichora	FHS – Ortho	SURG-107-03 - The Wrist/Hip Fracture Database
Ploeg	FEAS	Investigate the mechanics of initial fixation - Nobel Biocare
Ploeg	FEAS	Chair for Women in Engineering
Ploeg	FEAS	Patient Specific Bone and Joint Health Technologies

Ploeg	FEAS	MECH-069-19 Bone Bioreactor Research
Ploeg	FEAS	SCOMP-007-11 Novel Solutions for Intra-Operative Navigation using Patient-Specific Instrument Guides
Ploeg	FEAS	Functional Analysis of Joint Mechanics in Fresh-Frozen and Soft-Embalmed Cadavers.
Purzner	FHS – Surgery	SCOMP-012-22: Tissue identification using the iKnife for REIMS mass spectrometric analysis in neurosurgery.
Purzner	FHS – Surgery	SURG-566-22 A Biobank for Neurologic Tissue Research
Rainbow	FEAS	MECH-072-19 Examining the Results of Scapholunate Interosseous Ligament Reconstructive Surgery by Simulating Wrist Motion: a Cadaver Study.
Rainbow	FEAS	MECH-066-18 An Affordable and Intelligent Wearable System for Overuse Injury Prediction and Prevention.
Rainbow	FEAS	MECH-063-18 Effect of orthosis stiffness on foot arch behaviour
Rainbow	FEAS	MECH-062-18 Normative Database of Human Activity Biomechanics
Rainbow	FEAS	MECH-061-17 Control of foot and ankle mechanics during hopping: deciphering the role of the plantar fascia and intrinsic foot muscles.
Rainbow	FEAS	MECH-060-17 Multi-articular Foot Motion
Rainbow	FEAS	MECH-058-17 Measurement of Plantar Fascia Strain and Modulus with Ultrasound Shear Wave Elastography.
Rainbow	FEAS	MECH-052-15 Does Global Wrist Flexibility Affect Carpal Bone Motion Patterns?
Rainbow	FEAS	Mechanochemical Regulation of Muscle on Developing Cartilage
Rainbow	FEAS	Moving beyond bone mineral density: Computer models to help diagnose bone fragility
Rudan	FHS – Ortho	SURG-424-18 Tissue Identification Using the iKnife: A pilot study
Rudan	FHS – Ortho	SURG-311-14 36mm Ceramax™ Ceramic Hip System PMA Post-Approval Study: Short to Mid-Term Follow-up of New Study Subjects.
Rudan	FHS – Ortho	SURG-056-99 - Computer Enhancement of Orthopaedic Surgery
Rudan	FHS – Ortho	Waters Corporation
Sibley and Maslove	Other	MgSO4 and Atrial Fibrillation (Clinical Trial)
Simpson	FHS/FAS	GPU Server Administration
Simpson	FHS/FAS	DMED-2641-22 Machine-learning based image analysis for emergency medicine applications
Simpson	FHS/FAS	DBMS-126-21: Using Artificial Intelligence Machine Learning for The Ontario Health Data Platform (OHDP) COVID-19
Simpson	FHS/FAS	AI Can Dream, but Can It Trip?
Simpson	FHS/FAS	Prognostic and prediction models for progression-free survival, clinical response, and overall survival in patients with malignant pleural mesothelioma.
Simpson	FHS/FAS	Determinants of Poor Cardio Fitness Across the Breast Cancer Continuum
Simpson	FHS/FAS	Quantitative Image Analysis for Oncology

Simpson	FHS/FAS	Using AI to Investigate Opioid Prescriptions and Overdoses in Relation to the Onset of the COVID-19 Pandemic.
Ungi	FAS	Transcutaneous Ultrasound Image Analysis Research.
Wice	FHS	DBMS-124-21: Functional Analysis of Joint Mechanics in Fresh-Frozen and Soft-Embalmed Cadavers
Wilson	FHS	Twitter Vaccine Hesitancy
Wood	FHS – Ortho	SURG-575-22: Examining Factors Influencing Surgeons' Choice of Stem Fixation Type for Intra Capsular Hip Fractures
Wood	FHS – Ortho	SURG-467-19 Multi-Center Randomized Controlled Trial of Staged versus Simultaneous Bilateral Knee Arthroplasty.
Wood	FHS – Ortho	SURG-463-19 Clinical results of patellofemoral joint arthroplasty with and without patella resurfacing: Retrospective Review
Wood	FHS – Ortho	SURG-454-18 Cemented vs. Cementless Bipolar Hemiarthroplasty for the Intracapsular Hip Fractures in Elderly Population: Retrospective Review using the Canadian Joint Registry.
Wood	FHS – Ortho	SURG-427-18 Investigating outcomes in orthopaedic medicine
Wood	FHS – Ortho	SURG-387-17 Comparing a minimally invasive total hip arthroplasty technique to a standard technique: Superpath versus posterior approach.
Wood	FHS – Ortho	SURG-321-15 HIP fracture Accelerated surgical TreaTment And Care tracK (HIP ATTACK) – Randomized Controlled Trial of Accelerated Medical Clearance and Surgery versus Standard Care for Hip Fracture.
Wood	FHS – Ortho	Examining Factors Related to Subsequent Contralateral Hip Arthroscopy in a Cohort of Unilateral Hip Arthroscopy Patients
Wood	FHS – Ortho	A biomechanical assessment of the Exeter short revision stem as a primary total hip arthroplasty system
Wu	FEAS	Human-robot gait coordination and interaction
Yach	FHS – Ortho	SURG-586-22: Review of the KGH/KHSC Pelvic Fracture Pathway
Yach	FHS – Ortho	SURG-549-21: Clinical Outcomes and Radiographic Union of 2.7mm Screw Fixation for Medial Malleolus Fracture Fixation: A Chart Review.
Yach	FHS – Ortho	SURG-341-15 Isolated locked compression plating versus cable plating and strut allograft with cerclage wiring for Vancouver B1 periprosthetic femoral fractures: A Randomized Controlled Trial.
Yacob	FHS – Surgery	Nationwide Prospective Study of Juxta Renal Aortic Aneurysms Surgical Practices and Outcomes.
Yen	FHS – Ortho	SURG-670-22 Radiographic Progression of Degenerative Lumbar Spine Stenosis, is there any value of ordering multiple to look at disease progression?
Yen	FHS – Ortho	Radiographic Progression of Degenerative Lumbar Spine Stenosis, How recent does the latest MRI need to be before surgical intervention: A Retrospective Pilot Study.

Yen	FHS – Ortho	A Case of a Cauda Equina Injury Through Anterior Penetrating Wound.
Zuk	FHS	Risk Prediction and Deep Learning of Novel Maternal Risk Factors on Future Cardiovascular Events among Women in Canada

APPENDIX 5: SPACE USAGE

Despite the pandemic, over 250 individuals (residents, undergraduate students, graduate students, postdocs, faculty, and staff) accessed CHI. CHI provides space for meetings, lab work, etc.