YEAR END REPORT

2019

Connecting University of Waterloo researchers and Grand River Hospital clinicians to further health-related transformational research

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EXECUTIVE SUMMARY

The following report describes the 2019 research activities undertaken at Grand River Hospital (GRH) in partnership with University of Waterloo (UW) professors, alumni and/or institutes. This report, prepared by the Office of Research & Innovation at Grand River Hospital and presented to the Office of Research at the University of Waterloo on a yearly basis, demonstrates the ongoing commitment to fostering health-related transformational research.

Continuing to build new relationships and advance our research efforts
In 2019, four new UW partnered studies came forward for review and approval by the GRH Research Committee and one new partnership formed to support non-human research activities. In addition to these newly approved studies, there continues to be active work on 12 studies approved in previous years, and three studies came to conclusion. Engagements are also occurring on four other partnerships to plan forward project work for commencement in 2020.

Through the work of the Research Office Administrator position, partially funded by UW, 13 additional facilitated introductory connections between UW professors and alumni to GRH staff and clinicians to begin conversations regarding project ideation alignment to clinical needs, seeking expert consultation on research theme development, or possible partnerships for granting opportunities.

The Centre for Bioengineering and Biotechnology (CBB) continues to be a strong partner in the both research and education opportunities for GRH staff and clinicians. Ongoing work continues at GRH to support the CBB's NCERC CREATE grant 'needs first' graduate education program by participation on planning committees and acting as workshop presenters. Co-Hosted education sessions 'Pizza with the Profs' continues to be a successful event at the Freeport campus with seven education sessions held and average attendance of 25 GRH staff and clinicians.

Continued success and momentum in securing funding and resources to advance our research aspirations
An ongoing process for researchers is seeking funding opportunities through local, provincial, and federal for-profit and not-for-profit granting agencies. Partnerships Commitments with four UW professors on project proposals led to the provision of letters of support to accompany grant applications.

Proud of our collective accomplishments to date and looking forward to building on this foundation
The ongoing collaboration between our two institutions is a point of pride for GRH. We remain committed to actively nurturing partnerships and engagement through research to realize learnings and insights that inform and fuel transformation and innovation of how we work and deliver care.

INTRODUCTION

We are pleased to submit this annual report as an opportunity to take a moment and reflect on the milestones achieved and work completed by the many clinicians and staff at GRH, in conjunction with our partners. Along with the important work of direct and indirect patient care, hospital teams have undertaken and completed important research work that has produced valuable insights to the work at the bedside as well as contributions to scientific literature.

The end of 2019 brings Grand River Hospital and the University of Waterloo to the conclusion of year-five of the ongoing research relationship. The following report highlights the new studies and partnerships that have formed during this past year, a look ahead to the work being conducted now that that will lead to fruitful research studies in the future, and a look back on the studies that have come to conclusion.

NEW STUDIES & PARTNERSHIPS

During 2019, four new studies were brought forward for administrative and ethics approvals. We are excited to hear about the outcomes of these projects. In addition, one new partnership created as a support to non-human research activities.   Below is a brief summary of each of the new studies and any social engagement that has resulted from the project work. Summaries of ongoing studies (12 total) and closed studies (three total) for 2019 are included in appendix A and B respectively.

**DIGITAL PATHOLOGY: COMPUTATIONAL PEER REVIEW THROUGH IDENTIFICATION AND CAPTIONING OF GIGAPIXEL DIGITAL PATHOLOGY SCANS**
Dr. Adrian Batten, Pathologist, GRH
Dr. Hamid Tizhoosh, System Design Engineering, UW and Director of KIMIA Lab

"We are quite excited about this project that will give us the opportunity to be directly exposed to the evolving field of digital pathology. This work will help develop sophisticated computer methods for digital image search and identification and introduce this technology to pathology residents; helping shape care for the next generation of physicians."

Dr. Adrian Batten
Joint Chief of Laboratory Medicine
Grand River Hospital and St. Mary's General Hospital
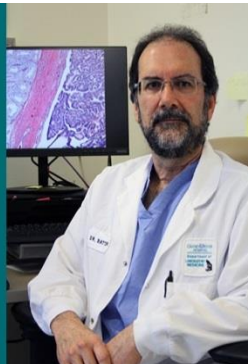
A joint project between the University of Waterloo, Grand River Hospital and Huron Digital Pathology, with an expected duration of five-year, the study team will be provided with access to hundreds of pathology images that will be digitized using a scanner provided by Huron Digital Pathology. The digital images, and their paired anonymized pathology reports, used by Dr. Tizhoosh's team will be the bases of an image search engine based on artificial intelligent software. Dr. Batten will validate the results of the search engine to determine if the results are correct, meaningful and useful.

GRH, UW, and Huron Digital Pathology shared website and social media coverage of the grant announcement and partnership.

ASSESSING INCIDENCE OF INJURY AMONG ACTIVE TRANSPORTATION USERS IN KITCHENER-WATERLOO
Ms. Sarah Lillico, Decision Support, GRH
Ms. Amanda Lavender, Decision Support, GRH
Dr. Jennifer Dean, School of Planning, UW

As a retrospective chart review, this study will assess the incidence and characteristics of injuries associated with active transportation and new mobilities in the cities of Kitchener and Waterloo. Specifically, the research will compare injury rates and type of injury among walkers, cyclists and e-scooter riders, comparing the incidence of injuries associated with active transportation users, the characteristics of the injury, how those injuries vary by mode of transport, and, how those injuries vary by time, demographic, and context. The results will inform municipal and regional transportation policy as well as provincial regulations for new mobilities (e-scooters).

A PATIENT-SPECIFIC IMAGING-BASED COMPUTATIONAL-MECHANICS FRAMEWORK FOR PREDICTION METASTATIC TUMOR SITES
Dr. Ernest Osei, Medical Physics, GRH
Dr. Nima Maftoon, Systems Design Engineering, UW

Scientists have long theorized that blood flow plays a vital role in cancer metastasis and more than two-thirds of cancer metastatic sites could be explained by the blood flow links between the primary and secondary sites. Blood flow affects the position where circulating tumor cells ultimately arrest in the vasculature and form a secondary site. The study team hypothesizes that a computational tool can be developed to predict the course of cancer metastasis in individual patients.

The objective of this study is to develop a tool for predicting cancer metastasis given the status of patients diagnosed with a primary tumor. This tool will use a patient-specific imaging-based framework to model the fluid dynamics within the patient's circulatory system and to simulate the separation, transportation and arrest of cancer cells in the body of the patient. In order to develop and validate this framework, the research team will be provided access to high-resolution clinical images (CT and MRI scans) of cancer patients. The simulation results of metastatic sites regarding each cancer patient will be used to compare to the actual tumor sites shown in the images.

AUTOMATED ROBUST DIRECT APERTURE OPTIMIZATION FOR RADIATION THERAPY TREATMENT PLANNING
Dr. Johnson Darko, Medical Physics, GRH
Dr. Houra Mahmoudzadeh, Management Science, UW

Despite many advances in radiation therapy treatment planning technology and software, the planning process remains a challenging and tedious task. There are often several conflicting objectives that need to be satisfied, such as dose to tumor versus dose to multiple surrounding healthy organs, and there is often a trade-off among these objectives. The quality of the plan depends on the parameters and weights that the planner inputs in the treatment planning software and the planning process often involves some trial and error process including adjusting various parameter settings until an acceptable plan is found. In such cases, the quality of the plan relies heavily on the expertise and level of experience of the planner. In addition, the planning process needs to incorporate several sources of possible changes in the anatomy that may degrade the quality of the treatment from what was planned. Examples include day-to-day changes to the anatomy, setup errors, dose calculation errors, or intra-fraction motion. These changes are amplified in cancer sites such as lung or breast, where the influence of respiratory motion is present. Most importantly, the extent of these changes is not predictable and are subject to uncertainty. State-of-the-art optimization techniques used for treatment planning do not typically account for these uncertain changes.

In this research program, the team will bring together the ideas of robust optimization and direct aperture optimization for treatment planning of radiation therapy. The team will view radiation therapy treatment planning as an optimization problem that includes all the realistic constraints of a treatment planning delivery with the goal of advancing the state-of the-art radiation therapy treatment planning and delivery systems. The focus of the study will be on breast cancer application where respiratory motion can significantly degrade the quality of the plan, especially for left-sided breast cancer in which the heart is at risk of excessive exposure to radiation.

MICROFLUIDE PLATFORM TO STUDY CELLULAR TOXICITY
Ms. Lisa Anstey, Medical Device Reprocessing Department, GRH
Dr. Chau-Minh Phan, Co-Founder Occublink, Centre for Ocular Research and Education, UW

Researchers at the Centre for Ocular Research and Education expressed a need related support services for sterilization. Dr. Chau-Minh Phan, and his team, have developed an acrylic microfluidic platform to test ophthalmic materials. This device requires low temperature sterilization methods that were not available within the team's laboratory. A connection, made through the Office of Research & Innovation, to meet with the Medical Device Reprocessing Department (MDRD) to discuss the opportunity for collaboration on sterilization services occurred. The partnership has been a great success and wonderful contribution to Dr. Phan's research. With the use of low temperature hydrogen peroxide sterilization services provided by MDRD, Dr. Phan has been able to successful grow cultures and test for cellular toxicity.

UPCOMING STUDIES

IN VITRO CHARACTERIZATION OF QIDNI BLOOD PURIFICATION DEVICE AND ITS COMPOENTS WITH HUMAN WHOLE BLOOD
Ms. Nan Miller, Nurse Practitioner, GRH
Dr. Morteza Ahmadi, QIDNI Labs (a Velocity company)

Using silicon nanofilters, Dr. Morteza Ahmadi and his research team have developed a portable device that offers blood filtration that is on par with traditional polymer dialyzers. The filters developed offer a specific pore size, which allows albumen to be blocked from the bloodstream, while allowing other essential proteins to pass through. These thin membranes also require less surface area than a regular blood dialyzer, which allows for a significantly smaller form factor. Because silicon nanotechnology is a mature field, the industry is more comfortable with the use of this material in the miniaturization of medical devices such as blood dialyzers. "Studies have shown that longer dialyzer treatment times can potentially be associated with prolonged survival. This renal replacement therapy device could reduce many of the costs associated with traditional dialysis equipment and services, creating an opportunity

for patients to have access to dialysis at any time," said Dr. Ahmadi.

QIDNI's commitment to keeping this technology work local will continue with a partnership with Grand River Hospital Regional Renal Program and Office of Research and Innovation. GRH Regional Renal Program and QIDNI Labs will embark on a series of clinical research studies that will rigorously examine the technology created by QIDNI for safety and efficacy. Work has been ongoing through 2019 to customize the protocol and implementation plan at GRH.

PHOTOACOUSTIC REMOTE SENSING (PARS) MICROSOPY OF SURGICAL RESECTION, NEEDLE BIOPSY, AND PAHTOLOGY SPECIMENS
Dr. Dimitrios Divaris, Pathologist, GRH
Mr. Kyle Difzaio, Pathology Assistant, GRH
Dr. Parsin Reza, System Design Engineering, UW

Photoacoustic Remote Sensing (PARS) is a new imaging technology based on a University of Alberta discovery of a new physical phenomenon. This is a pilot study evaluating the utility of PARS to distinguish pre-cancer and cancer in excised human tissue samples. This study will primarily focus on imaging various types of skin cancer, gastrointestinal pathologies, thyroid and parathyroid tissue, oropharyngeal cancers, and lymph nodes potentially involved with metastases. This study will be a non-interventional observational study of tissues excised for standard medical indications.

Throughout 2019, project planning has been ongoing for study approval and implementation in early 2020. As a part of the collaboration, Dr. Reza and his team will be provided physician space to set-up and test their imaging equipment at GRH, and provided access to archived tissue samples in order to conduct testing on their technology.

SMART MULTI-DOSE BLISTER PACKAGING: INTEGRATION AND IMPACT ON MEDICATION INTAKE BEHAVIOUR
Ms. Luna Salameh, Renal Program, GRH
Dr. Tejal Patel, School of Pharmacy, UW

Chronic diseases often require long-term therapy with complex medication regimens, which are difficult to manage and require many prescriptions with multiple daily dosing. Non-adherence to medications can lead to non-optimal management of disease, poor clinical outcomes and cost to health care system. The use of technology has grown rapidly in the past two decades to address non-adherence and seems to affect medication adherence. However, little has occurred with respect to smart devices for multiple daily medication regimens. Literature has reported various health behaviour theories in order to identify barriers to change when it comes to medication intake. By applying one or more than one of these behaviour theories, one can understand the process and design effective interventions to address issues of complex medication regimen. This study aims to explore the integration of smart multi-dose blister packaging for daily use by patients and will investigate their medication intake behavior.

GRH will be collaborating with Dr. Patel in order to support patient recruitment efforts.

EVALUATION OF PECTORALIS MAJOR REGIONAL ACTIVATION IN BREAST CANCER SURVIVORS AND HEALTHY CONTOLS
Ms. Hanna Stracey, Nurse Practitioner, GRH
Ms. Tea Lulic, PhD Candidate, UW

Breast cancer survivors (BCS) are at an increased risk of developing shoulder disability due to the effects of oncological treatment. In particular, irradiation of muscle tissue and peripheral nerves lead to extensive long-term arm disability, leading to reduced quality of life. Radiation particularly damages the pectoralis major muscle, due to the muscle's position relative to the breast. However, how radiation affects neuromusculoskeletal control of pectoralis major muscle is unknown and understudied. The knowledge gained in this study is fundamental for the development of targeted rehabilitation protocols aimed at recovery of pectoralis major following oncological treatment.

GRANT APPLICATIONS AND FUNDING AWARDS

Our office was pleased to facilitate a number of collaborative discussions regarding potential future research partnerships. On behalf of the studies teams, a number of Letters of Support were generated to accompany grant application processes. We look forward to hearing about application success and initiation of project work.

Applications:
- Dr. Marina Mourtzakis, Associate Professor Department of Kinesiology and Associate Chair of Applied Research, Partnerships and Outreach for the Center for Community, Clinical and Applied Research Excellence (CCCARE) Center applied to the Canadian Institute of Health Research (CIHR) to support a project entitled "A multimodal approach to assessment of metabolic health in breast cancer patients". Dr. Nadia Califaretti, Oncologist, will collaborate on the project. The project aims to characterize body composition and metabolic phenotypes in newly diagnosed breast cancer patients using a multimodal approach, evaluate changes in muscle health during nutrition, and exercise therapy. A team of GRH dieticians, physicians and staff will provide consultation on study design and performance metrics and will work closely to support patient screening for study eligibility, patient recruitment, patient consent and data collection. The project was unsuccessful during the 2018 granting year, but has be resubmitted for the 2019 CIHR application process.
- Dr. Paul Stolee, Professor, Faculty of Applied Health Sciences, has explored additional granting opportunities with GRH. The project entitled "Improving Care Transitions for Older Rehabilitation Patients: The Info Rehab Model" is strongly supported by the Rehabilitation program at our Freeport Campus. Although unsuccessful during the 2018 granting season, the Rehab program continues to support the team's efforts and a subsequent letter of support was provided for submission to the 2019 CIHR grant competition.
- Dr. Omar Ramahi, Professor, Electrical and Computer Engineering, applied for a National Institutes of Health grant for a project entitled "Intelligent Microwave Microscopy for Breast Cancer Detection." The hospital's mammography program has expressed interest to participate in feasibility testing of his device. A letter of support was provided to Dr. Ramahi to support his grant application.
- Dr. Monica Maly, Department of Kinesiology, applied for two granting opportunities in 2019. Letters of support were provided to The Arthritis Society and the Canadian Institute of Health Research. Dr. Maly's research focuses on osteoarthritis, an area of interest by our physio and occupational therapists at our Freeport Campus.

Awards:
From previous grant application processes that occurred in 2019, we are happy to report that two studies received new or additional funding and are in the processes of activating at GRH.

- Dr. Brian Laird, Assistant Professor, School of Public Health and Health Systems applied to CIHR to support his ongoing research in environmental contaminates and their impact to nutritional markers. As a partner in the study, GRH would provide laboratory services analyzing frozen plasma samples for various vitamins and minerals. In early 2020, work began to transfer samples to GRH for laboratory processing
- The Arthritis Society awarded the Stars Career Development Award Dr. Monica Maly. Planning discussions are scheduled for early 2020 to continue discussions on how GRH can support and participate in research activities.

CONSULTATIONS AND POTENTIAL PARTNERSHIPS

While not formalized into project work at this point in time, the ORI has facilitated meetings/introductions with the following UW professors, alumni, or institutes who have expressed interest in research collaborations:

- Dr. James Tung, Dr. Arash Arami, Dr. Stewart McLachlin, all with Mechanical and Mechatronics Engineering, research interests – exoskeletons, orthobiomechanics, and human motion analysis
- Dr.Oleg Michailovich, Electrical and Computer Engineering, research interest – diffusion MRI for mild cognitive impairment diagnosis
- Dr. Siby Samuel, System Design Engineering, research interest – cognitive learning processes
- Dr. Marianna Foldvari, School of Pharmacy, research interest – transdermal drug delivery
- Dr. Aidin Taeb, Centre for Intelligent Antenna and Radio Systems, research interest – skin cancer detection
- Dr. Plinio Morita, School of Public Health & Health Systems, research interest – patient monitoring
- Dr. Tom Willett, System Design Engineering, Dr. Clarke Dickerson, Department of Kinesiology, research interest – radiotherapy impacts on the biomechanical properties of tissues
- Dr. Steven Fischer, Kinesiology, research interest – musculoskeletal injuries among healthcare workers
- Amina Health - Bobby Green (Velocity company), research interest – point of care testing for ferritin deficiencies
- NERv Technologies – Youssef Helwa, Amr Abdelgawad (Velocity company), research interest – post-operative complications due to gastrointestinal leakage
- Membio - Shane Kilpatrick (Velocity company), research interest – red blood cell production
- Vena Medical – Michael Phillips, Phillip Cooper (Velocity company), research interest – fibre optic use in interventional radiology

EXPANDING OUR NETWORK, RELATIONSHIPS AND INTERNAL UNDERSTANDING OF OUR PARTNER ECOSYSTEM

ORI was pleased to participate in a number of events hosted by the University of Waterloo and/or the Centre for Bioengineering and Biotechnology during 2019. These events were extended to clinicians and staff for participation. Representation from GRH was included in the following events:

- CBB Annual General Meeting Presentation & Networking event
- Faculty Research Networking Event: Clinical Application of Medical Imaging Technologies

- Waterloo Innovation Summit
- Health Canada Regulatory Insights Workshop

NSERC CREATE

Exciting work occurred in 2019 in support of the Center for Bioengineering and Biotechnology NSERC grant for the CREATE program. The first "needs-first" graduate program in Canada, in which trainees learn to directly interact with end-users and stakeholders in the patient, medical, biotechnology industry communities to co-discover technology problems and solutions. The program's long-term objective is to produce high-quality personnel capable of thriving in a biomedical technology career.

In addition to the GRH VP of Research and Innovation participating as a member of grants Program Committee, Sarah Laferriere, has participated in program development meetings, and Carla Girolametto provided an education session for program attendee entitled "Regulatory Aspect and Standards within Healthcare Institutions."

A team of staff also supported CBB's first annual CREATE Bio-hackathon and Summer School. The 3-day event, held June 2019, provided students the opportunity to work in interdisciplinary teams, interact with healthcare professionals to identify unmet needs and ideate a solution to tackle a specific problem through design thinking. Teams each presented their solutions and prizes awarded to the top two teams. In addition to Carla Girolametto's participation as a judge for the event, nurse practitioners Hannah Stracey and Margaret Mayer provided clinical expertise as panel members during the need's identification portion of the event.

ACCELERATOR CENTRE

Ongoing collaborative talks have been occurring between leadership at Grand River Hospital and UWs Accelerator Centre to increase opportunities of engagement between start-ups and GRH staff and clinicians. More details to follow as partnership talks continue.

PIZZA WITH THE PROFS

Staff and clinicians continue to participate in education sessions co-hosted with the Centre for Bioengineering and Biotechnology (CBB). Seven educational sessions highlighting the research work of a number of University of Waterloo professors occurred. Events occur at the Freeport campus, the location of GRH's regional rehabilitation program, complex continuing care program, and specialized mental health services. Over 115 individuals have registered to receive the event invitation through direct email link; average attendance at each session is 25. With the use of Ontario Telemedicine Equipment (OTN), many sessions are recorded and accessible for viewing by those not able to attend the live presentations. Staff/clinicians are able to access the recorded sessions through the hospitals intranet.

Speakers and topics:

Dr. Clark Dickerson Department of Kinesiology	**Dr. Monica Maly** Department of Kinesiology
Shoulder biomechanics: Morphing laboratory insights into clinical applications	Mechanics of tissue damage in osteoarthritis: Leveraging this knowledge to improve care
Dr. Tom Willett System Design Engineering	**Dr. James Tung** Mechanical & Mechatronics Engineering
Investigation and innovation for improved bone health and repair	Should we worry about automation and artificial intelligence in rehabilitation?
Dr. Andrew Laing Department of Kinesiology	**Dr. Steven Fischer** Department of Kinesiology
Improving independence in older adults through injury prevention: A biomechanical perspective	Caring for those who care for us: Musculoskeletal injury prevention for health care professionals
Dr. Susanne Tyas School of Public Health and Health Systems	Early-life factors and late-life cognition: What nuns can teach us about why some people develop dementia while others do not

REFLECTIONS AND LOOKING FORWARD

The ongoing collaboration between our two institutions is a point of pride for GRH. We remain committed to actively nurturing partnerships and engagement through research to realize learnings and insights that inform and fuel transformation and innovation of how we work and deliver care.

APPENDIX A

ACTIVE, ONGOING STUDIES

ASSESSING THE VISION NEEDS OF THE GRH FREEPORT CAMPUS INPATIENT POPULATION
Dr. Abhishek Narayan, Chief of Complex Continuing Care and Rehabilitation, GRH
Dr. Susan Leat, School of Optometry and Vision Science, UW

"If we're able to assess a patient's vision in hospital, not only can we improve the care we provide to the patient, we can also help prevent readmission by helping patients' understand their vision needs."

Dr. Abhishek Narayan

Vision loss is a risk factor for falls and poor health outcomes, but vision is not routinely measured on hospital admittance. Knowing the vision loss and eye care needs of patients will enable staff to take precautions, potentially reducing falls within the hospital, improving recovery and increasing functional independence back into the community.

The study aims to determine the prevalence of unmanaged/undiagnosed ocular disorders, vision care requirements and current levels of vision among inpatients at Grand River Hospital - Freeport Campus. To complete this, the study team will implement an oral questionnaire and a brief vision screening assessment with patients. The study will also establish the value and most effective components of a screening tool to identify patients who 1) would benefit from eye care in a potential out-patient eye clinic, 2) for whom precautions should be used to prevent falls during their hospital stay 3) may benefit from vision rehabilitation.

Both GRH and UW shared website and social media stories highlighting the study.

FEASIBILITY OF SINGLE EXPOSURE DUAL ENERGY SUBTRACTION WITH A MULTI-ENERGY DIGITAL RADIOGRAPHY DETECTOR FOR LUNG LESION DETECTION
Dr. Vikram Venkatesh, Radiologist, GRH
Dr. Karim Karim, Electrical and Computer Engineering, UW, and Chief Technology Officer, KA Imaging

"Partnering with Grand River Hospital is a tremendous opportunity to trial this innovation at home in the Waterloo Region. We look forward to continuing our partnership with GRH, working together to improve patient care in our region."

Amol Karnick,
President and chief executive officer
KA Imaging

The KA Imaging and GRH research study team

To improve current medical imaging technology of visualizing lung lesions with X-ray, a Multi-Energy digital flat panel detector for Single Exposure Dual-Energy Subtraction radiography has been developed by KA Imaging Inc. to provide images with enhanced tissue differentiation. The technology allows the visualization of anomalies such as pulmonary nodules which are usually not well distinguished on regular x-ray and require more comprehensive imaging tools like CT.

A feasibility study will investigate the imaging characteristics captured by KA Imaging's detector. Study participants, recruited by GRH will undergo testing by KA Imaging's detector and the current standard of

care MRI. A GRH radiologist will evaluate the dual-energy images qualitatively against the CT image to determine the differences in image characteristics.

A successful outcome to this research will mean an improvement on the accessibility to better quality of healthcare as it can establish the feasibility of Single Exposure Dual-Energy Subtraction with Multi-energy radiography detector for lung lesions imaging and reduce the necessity of redundant CT exams.

Both GRH and UW shared website and social media stories highlighting the study. Excellent media coverage from a number of local outlets was also seen (CBC, CTV News, Canadian Healthcare Technology).

PREDICTING RESOURCE USE OF COMMUNITY MENTAL HEALTH SERVICES AT THE TRANSITION FROM IN-PATIENT PSYCHIATRY
Ben Windling, Decision Support, GRH
Dr. John Hirdes, School of Public Health & Health Systems, UW
Ken (Nam) Tran, PhD Candidate, Health Informatics, UW

As a retrospective review of health records, the objective of the study is to examine the relationship between the resource use of community mental health services and the needs of clients discharged from in-patient psychiatry. Data from both Grand River Hospital and the Canadian Mental Health Association-Waterloo Wellington will be used to explore this relationship and answer the following questions: 1) Who will subsequently use community mental health services and what are their clinical characteristics; 2) Does the system for classification of in-patient psychiatry (SCIPP) predict the resources use in community mental health services 3) Do characteristics of acute psychiatric clients at discharge predict their usage of community mental health services?

THE INCIDENCE AND PREVENTION OF GASTROINTESTINAL BLEEDING IN ONCOLOGY PATIENTS
Michael Collins, Pharmacist, GRH
Dr. Tom McFarlane, School of Pharmacy, UW
Connor Prince, BScPharm (Candidate), UW

As a student lead project, a retrospective review of health records will be conducted. The study aims to discover the incidence and risk factors for gastrointestinal (GI) bleeding in hospitalized oncology patients and if there are remitting factors that may prevent GI bleeding from occurring.

Determinants and outcomes of psychiatric youth readmission (DETOUR)
Dr. John Vanderkooy, Psychiatrist
Dr. Mark Ferro, School of Public Health & Health Systems

The main research question aims to understand the determinants and outcomes associated with psychiatric readmission among youth. The researchers will recruit a cohort of youth aged 10-16 years who are currently inpatients for a first psychiatric hospitalization at McMaster Children's Hospital and Grand River Hospital. Youth will be followed for 12 months after discharge and tracked for readmission by collecting data from youth and their guardians during their first hospitalization and again at 1, 3, 6, and 12 months post-discharge. The utility of the primary data will be enhanced by linkage to provincial health records. The myEXP mobile app will capture patients' perspectives on hospitalization(s). This will allow the researchers to more comprehensively identify at-risk youth, inform services offered during

hospitalization and at discharge, and improve coordination of care in an effort to reduce psychiatric readmissions and system burdens.

User Evaluation of Modeling and Control of Human-Robot Rehabilitation System for the Upper Extremity
Ms. Ellen Richards, Clinical Manager Stroke
Dr. John McPhee, Systems Design Engineering
Dr. Borna Ghannadi, post-doctoral student

The objective of this research is to improve the performance of the upper extremity stroke rehabilitation robot with novel controllers. These results are pertinent to modern-day rehabilitation of stroke survivors in a clinical environment. The long term goal of this research is to elicit motor recovery of the shoulder and elbow joints of post-stroke patients by repetitive programmed exercises. The benefits, should this innovation bear the anticipated results, would include improved motor control, muscle strength, and range of motion in a systematic approach. This study has taken a significant amount of time to prepare for activation. While the GRH administrative approval process occurred in a four-week period, the joint ethics review between THREB and UW ORE requested that the human-robot rehabilitation system undergo a safety review that, as we understand, took longer than anticipated to complete. In addition, staffing changes within the ORE inadvertently delayed the normal review and approval process. In January 2018, the study team has reconnected with the GRH team with the aim of moving forward with study activation.

Toolkit for Assessing Human Balance and Mobility
Dr. Doug Dittmer, Medical Director Rehabilitation
Dr. Bill McIlroy, Kinesiology
Dr. Don Cowan, Computer Science

The project will test a toolkit for assessing human balance and mobility at the Freeport Campus outpatient rehabilitation clinic. The toolkit was one of 31 projects to receive funding from the Canadian Centre for Aging and Brain Health Innovation, operationalized through Baycrest Health Sciences through its Spark program. Using a tablet and wearable technologies, the toolkit will allow health care professional to capture data from each session with a patient for analysis. The system samples and synchronizes from multiple inexpensive wearable devises and generates a patient assessment and possible actions to improve the health of the patient. The system will also produce a large data set of clinical results (big data) that can be analyzed for further insights into frailty and other medical conditions related to balance.

First approved in 2017, the study received additional funding in 2018 to re-survey physiotherapists regard the newest version of the toolkit.

A Pilot Study of a Nurse and Pharmacist Led Ontario Telemedicine Network (OTN) Based Clinic for Management of Prostate Cancer Patients on Oral Therapy
Dr. Stacey Hubay, Medical Oncologist
Dr. Tom McFarlane, School of Pharmacy

The team of researchers has developed a randomized, open label study to evaluate a nurse- and pharmacist-led clinic conducted remotely from Grand River Regional Cancer Centre (GRRCC) using OTN teleconferencing as a platform for patients with metastatic prostate cancer receiving oral chemotherapy

agents. The primary outcome will be a comparison of patient satisfaction with overall care utilizing a validated scale between the group of patients using the OTN clinic and a matched group of control patients receiving conventional care at GRRCC. The secondary objectives will be to examine the feasibility of use of the OTN platform with a semi-structured interview conducted with patients in the OTN cohort at the conclusion of the study, and to present a descriptive analysis of toxicity-related interventions made in patients on the trial. The measurement of the effectiveness and acceptability of the use of the telemedicine modality between clinicians and patients will inform future decisions on the feasibility of this modality to increase accessibility to care for patients. To date, 30 of the total 80 patients have been recruited to the study with 15 patients randomized to the OTN arm of the study.

The study was presented by Carla Girolametto at the Waterloo-Wellington Clinical Research & Quality Improvement Symposium, at the Society of Clinical Research Associated (SOCRA) Conference and at the Canadian Association of Nurses in Oncology conference. Dr. McFarlane also provided a poster presentation at the Clinical Oncology Society of Australia (COSA) conference in Perth Australia

Predicting Aggressive Behaviours of Cancer Cells from the General Blood Circulation
Dr. Mala Bahl, Medical Oncologist
Dr. Jonathan Blay, School of Pharmacy

The team is studying the potentially aggressive behaviours of cancer cells that are circulating in the peripheral blood of colorectal and breast cancer patients. These behaviours will be detected by providing the cells with protein factors that favour their vascular capture and development into metastases. Twenty patients diagnosed with stage IV Colorectal or Breast Cancer are being recruited by the medical oncologists at Grand River Regional Cancer Centre, the blood collection occurs at Grand River Hospital, the blood is then transferred to Dr. Blay's Lab at the UW School of Pharmacy for purification and analysis of the circulating cells. As a result of this study the researchers hope to be able to identify features of the circulating tumor cells that will provide information with respect to patient prognosis and treatment of cancer. To date, 26 patients have been recruited to the study and recruitment will continue throughout 2019.

Preliminary study results have been presented at three key conferences in cancer research and biotechnology in 2017 (Canadian Association of Pharmacy in Oncology, Banff, AB; Cancer Research Symposium of the Institute for Comparative Cancer Investigation, Guelph, ON; University of Waterloo Biotechnology and Bioengineering Conference, Waterloo, ON). Thus far, isolation of the circulating cells has been successful and the team is investigating the features of these cells that might provide information or useful biomarkers for prediction of courses of disease.

Biodistribution and Efficacy of Gold Nanoparticles for Prostate Cancer Targeting
Dr. Ernest Osei and Mr. Andre Fleck, Medical Physics Department
Dr. Shawn Wettig, School of Pharmacy
Dr. Tony Mutsaers, Ontario Veterinary College at the University of Guelph

Through a research partnership between GRH, the University of Waterloo, and the Ontario Veterinary College, a team of researchers are fine-tuning a treatment to use gold nanoparticles to target prostate cancer. The project is now completing a bio-distribution and toxicity studies in mice. In the near future, the team members hope to offer the treatment to canines that have terminal prostate cancer. A successful treatment of the canine will then help translate the model to the human population. An abstract of this research was presented at the Canadian Organization of Medical Physicists (COMP) 2018 annual conference.
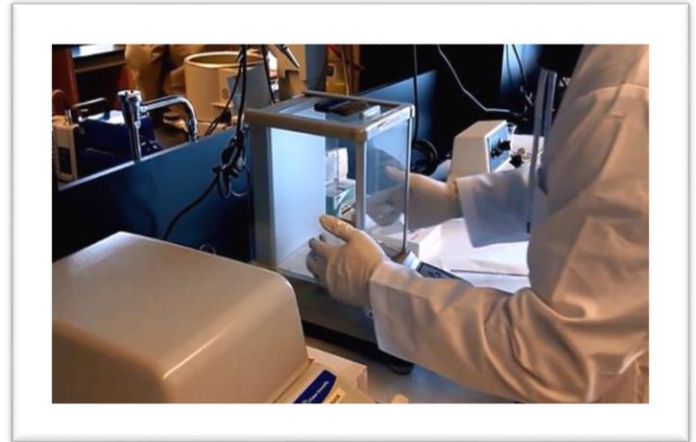
Imaging Guided Radiation Therapy
Dr. Runquing Jiang, Medical Physicist
Mark Servos, Department of Biology

Improving both the CT imaging and effectiveness of radiotherapy is crucial to furthering the efficacy of image guided radiation therapy (IGRT) for precision prostate cancer treatment. In this project, the research team will use prostate cancer cell lines to test the feasibility of novel biocompatible nanomaterials as CT contrast agents and radiosensitizers.

The nanomaterials will be protein-coated gold nanoclusters encapsulated in liposomes, which are FDA approved phospholipid nano-shells similar to cell-membranes in terms of their chemical and physical properties. In these applications, it is expected that the nanomaterials will have several important advantages over currently used small molecule-based CT contrast agents and radiosensitizers, including longer blood-circulation time, higher X-ray attenuation, highly effective radiotherapy with lower radiation dose, and less harm to renally impaired patients and those patients hypersensitive to iodinated chemicals. The results of the research project will be relevant for clinical diagnostics, prognostics, and treatment of prostate cancer.

Quantum Physics and Cancer
Dr. Ernest Osei, Director of the Medical Physics department at Grand River Hospital
Dr. Raymond LaFlamme, Mike and Ophelia Lazaridis "John von Neumann" Chair in Quantum Information and Director of the Canadian Institute for Advanced Research (CIFAR) Quantum Information Processing program at University of Waterloo.

The purpose of this research is to initiate the exploration of the potential interactions between Quantum Physics and Cancer and how Quantum Physics tools could be utilized to improve the treatment/diagnosis of cancer. A few areas being explored amongst others are: a comprehensive literature review of quantum applications in cancer treatment/diagnosis; the feasibility of increasing precision in targeting cancer tumors in radiation treatment delivery by using both amplitude and phase control; the study and application of machine learning techniques to historic treatment planning information stored at Grand River Regional Cancer Centre (GRRCC) and the utilization of the outputs in choosing the optimal radiation treatment route.

APPENDIX B

CLOSED STUDIES

Care of Frail, Acutely Ill Older Persons: Making Health Care Work like a System (interRAI Acute Care Pilot Subproject)
Ms. Chantelle Archer, Clinical Nurse Specialist Medicine
Dr. John Hirdes, School of Public Health and Health Systems

The study aim is to better understand the trajectory of care (what makes older persons vulnerable and what are risk factors for admission to hospital and intensive care units) once admitted, what determines their long term function and how they recover from acute illness. It is anticipated that the study will yield strategies to provide evidence to assist clinicians in discussing treatment choices and plans of care for frail older persons. The study will also provide insights about predictors of alternate level of care (ALC) status that can be identified in the emergency department or on admission to an inpatient bed. This study is part of a pan-Canadian study funded by the Canadian Frailty Network. The results from this study will identify those individuals at higher risk of requiring an acute hospitalization, predict the need for nursing home resources after an acute episode of hospitalization and define the added value of a standardized geriatric assessment to predict outcomes after an acute care hospitalization.

At the end of the first year of the study, 270 patient participants had completed the contact assessment and 88 patients had completed the acute care survey. Data collection will continue until 350 contact assessments are completed and 109 acute care assessments are completed. A retrospective review of records is being conducted to compile data on completion of AUA screeners during the same time period. Focus groups with staff were also scheduled during the year. Dr. Hirdes presented preliminary study findings to clinical leaders at the hospital in September 2018.

Data collection has been completed at GRH and the study has been closed. However, all data-analysis has not been completed for the multi-center portion of the study as other sites are continuing data collection due to delayed project starts.

NEURAL CORRELATES OF SENSORY-SPECIFIC REACTIVATION IN EPISODIC MEMORY RETRIEVAL OF DRAWN, WRITTEN, AND SEMANTICALLY ENCODED WORDS
Diana Brodrecht, Medical Imaging Technician, GRH
Dr. Myra Fernandes, Department Psychology, UW
Melissa Meade, Student, UW

In recent work, the researchers have shown that drawing boosts memory relative to writing, listing characteristics, and visualizing an item, indicating that drawing information leads to a very robust memory trace. The team suggests that drawing might lead to the integration of multiple memory traces, specifically, a visual imagery trace, motor trace, and further, drawing may also promote a deeper level of semantic processing. Other research (Vaidya, Zhao, Desmond, & Gabrieli, 2002) has demonstrated that when remembering information studied in a picture format, neural activity related to processing of pictorial information is greater than when remembering words.

The study hypothesizes that the various memory traces involved in drawing become reactivated when retrieving drawn information and thereby support and facilitate the retrieval process relative to other types of encoding tasks such as writing and listing words. Examining the neural activity associated with

retrieval of information studied using various tasks (drawing, writing, and listing words) will advance scientific understanding of the mechanism by which different encoding methods benefit memory performance.

The study team recruited healthy subjects to participate in the study through recruitment at the University. Grand River Hospital conducted functional MRI imaging on behalf of the study team.

The study team compared memory performance, and the brain regions activated, when participants completed a recognition memory task for words that had been encoded using a drawing, writing, or listing semantic attributes technique for a set of to-be-remembered words.

A total of 20 young adult volunteer participants were recruited from the University of Waterloo. They studied 90 words outside of the MRI scanner and then performed a word recognition test while in the scanner. Analysis of memory performance showed that words drawn at encoding were remembered significantly better than those written out. Analysis of the brain activation data is on-going. The findings obtained in this study will advance the understanding of the neural mechanisms underlying memory performance, and will highlight the best technique to maximize memory performance.

PUTTING QUALITY FOOD ON THE TRAY: PATIENT SATISFACTION OF FOOD IN ONTARIO HOSPITALS
Karen Gosine, Dietitian, Nutrition and Food Services, GRH
Dr. Lisa Duizer, Department of Food Science, University of Guelph
Dr. Heather Keller, Kinesiology, University of Waterloo

> "The University of Waterloo's work with Grand River Hospital is a natural collaboration. The hospital's expertise and strength of clinical experience goes hand-in-hand with UW's research expertise. We have a powerful and positive relationship."
>
> Heather Keller
> Schlegel Research Chair, Aging and Nutrition
> Professor, Department of Kinesiology
> University of Waterloo

The overall aim of this project is to raise awareness of the importance of the quality of food served in Ontario hospitals to food satisfaction and intake of food. Patient satisfaction in food, food waste, and perceptions of food quality and challenges to serving quality food will all be measured by 19 participating hospitals.

A key anticipated outcome of this work will be that food is recognized as a contributor to health and well-being of Ontario hospital patients. Hospital patients will be invited to participate in a hospital food satisfaction survey. Nutrition and food services staff will be invited to participate in focus groups or individual interview sessions.

GRH released a website story and social media release during nutrition week, March 15, 2019.

Data was collected from November 19, 2018 to February 25, 2019. During this time, 76 patients completed a food satisfaction survey along with a food intake questionnaire. Additionally, the Project Coordinator conducted four individual interviews and two focus groups on February 27, 2019 at the KW campus along with one focus group at the Freeport campus on March 18, 2019 with individuals from various areas of food service, to explore perspectives on what is going well and areas for improvement, with respect to providing food to patients. Data collection will wrap up by December 2019 and final data analysis will be completed across 17 participating hospitals in Ontario by August 2020.