Creation of the Mitochondrial Patient Registry

Supervisor: Dr. Martin Holcik

External Partners: MitoCanada, MitoCODE

Proposed Project

The objective of this project is to begin the development of the registry of mitochondrial patients in Canada as part of the MitoCODE platform. This will entail researching and comparing other existing patient registry platforms and establishing set of rules and criteria for the MitoCODE registry. The secondary objective is to analyze the available electronic health records to begin to uncover links between mitochondrial and inflammatory/immune diseases.

The context.

Mitochondrial diseases are a large group of clinically and genetically heterogeneous disorders. Clinically, they present at any age, show a wide spectrum of organ system dysfunction, and range in severity from relatively mild disease to neonatal or even antenatal lethal presentations. Prevalence estimates are variable but conservatively, mitochondrial diseases affect at least 1 in 8,500 persons. Research into mitochondrial disease processes and treatments is limited yet has great potential to improve care and outcomes for affected individuals and is also likely to have implications for those affected by more common chronic diseases that have features of mitochondrial dysfunction (e.g., Alzheimer's disease, Parkinson's disease, diabetes). Due to the variety of symptoms associated with mitochondrial disease, it often takes many years of uncertainty, frustration, and endurance for patients to receive an accurate diagnosis. Even after diagnosis is given, patients with mitochondrial diseases face another significant challenge when they learn that the treatment may not exist. An additional challenge for both patients and health professionals (clinicians and researchers alike) is the fact that there is no centralized registry of mitochondrial patients in Canada. MitoCODE is envisioned to be a comprehensive, first-in-the-world patient-centered data management platform for collecting, sharing and analysing clinical and research data, serving both as a patient and a clinician/research portal.

Proposed Team.

The student team will consist of 3 students from the MSC HSTP program. Ideally the students will have experience with conducting literature review and analysis of databases, and basic training in epidemiology. Experience with patient partnership is an asset. The duration of the project is 18 months.

Project title: Assessing acceptability, understandability, and effectiveness of alternative donor screening questions for blood and plasma donors

Organization: Canadian Blood Services

Supervisor: Dr. Jennie Haw

Background/context: Canadian Blood Services is responsible for managing the national supply of blood, plasma, stem cells, and organs and tissues for all provinces and territories (excluding Quebec) to meet patient need. A key area of focus for the blood operator is to develop effective donor policy that is maximally inclusive while ensuring the safety and sufficiency of the Canadian blood supply. For over 10 years, Canadian Blood Services has been committed to advancing donor policies related to gay, bisexual and other men who have sex with men (gbMSM) and trans populations. While progress has been made to decrease the MSM donor deferral policy from an indefinite to a 3-month period, Canadian Blood Services continues to prioritize generating evidence to support further advancements. The blood operator must provide sufficient evidence to receive regulatory approval from Health Canada to implement any changes to donor screening and donor eligibility criteria that may affect the health of the recipient.

Alternative donor screening questions may be one way to be more inclusive of gbMSM and trans populations. Prior to implementing these changes, Canadian Blood Services must examine how changes may be received by current donors to ensure that they will not lead to significant donor loss.

Objective: The aim of this project is to assess acceptability, understandability, and effectiveness of alternative donor screening questions to current blood and plasma donors. Alternative donor screening questions may include: 1) a two-step system to ask all donors their sex and gender to address the limitations of a binary system of gender and enable donors to answer according to their identified gender; 2) alternative sexual risk behaviour questions in the donor health questionnaire to move towards enabling low-risk sexually active gbMSM to donate.

Research project components/opportunities: This project is a 2-year, national mixed-methods study. Students will focus primarily on the qualitative components of the study; however, if there is interest, there may be opportunities to contribute to the quantitative components of the project. Depending on interests and skills, students may participate in all aspects of the research project including:

- Literature review
- Development of semi-structured interview guides
- Data generation and analysis
- Writing up of research results, including opportunities for publication in peer-reviewed journals and knowledge translation activities

Proposed team: Up to 3 students

Canadian Blood Services
BLOOD
PLASMA
STEM CELLS
ORGANS
& TISSUES

Student Project Proposal
Master of Science in Health: Science, Technology and Policy
Carleton University, Ottawa, Canada

Proposed Project:
Effect of Increasing Sleep Duration on Insulin Sensitivity in Adolescents having Risk Factors for Type 2 Diabetes

Supervisor: Dr. Jean-Philippe Chaput, Children's Hospital of Eastern Ontario

Objective:
To determine if extending sleep duration improves insulin sensitivity in adolescents presenting with risk factors for type 2 diabetes.

Background:
The influence of sleep extension on glucose homeostasis in adolescents at risk for type 2 diabetes is unknown. This issue is of high clinical relevance given the high prevalence of sleep deprivation in this population and the accumulating body of evidence indicating that having a good night's sleep is important for the prevention of chronic diseases including type 2 diabetes. We hypothesize that compared with decreasing sleep duration, increasing sleep duration by 1.5 hours over 1 week will improve insulin sensitivity. Using a randomized, counterbalanced, 2-condition crossover design, 30 obese adolescents between 13 and 18 years of age who have insulin resistance will complete the study. Participants will sleep their typical amount at home for 1 week and will then be randomized to either increase or decrease their time in bed by 1.5 hours per night for 1 week, completing the alternate schedule on the fourth week (washout period of at least 1 week between sleep conditions). This procedure will result in a targeted 3-hour time in bed difference between conditions. Sleep will be objectively measured using actigraphy (Actiwatch) and sleep schedule adherence will be promoted by providing fixed bedtimes and wake times during the experimental weeks, and will be monitored through phone calls to the research center. We will then compare outcome measures between both sleep conditions at the end (on day 8 of each study week). The primary outcome measure will be insulin sensitivity as measured by the homeostasis model assessment of insulin resistance (HOMA-IR; hepatic insulin sensitivity) and the Matsuda index (total body insulin sensitivity).

Research Project Components:
1. Review the literature on the topic
2. Recruit participants, collect data, and analyze data
3. Present research findings

Proposed Team:
Data collection is ongoing for this research project and only 1 student from the MSc HTSP program is needed. The student will be part of a research team assigned to this project that includes one Principal Investigator, 1 PhD student, 1 MSc student, 1 research nurse, and undergraduate students.

Duration: The project will require 18-20 months to complete.

Logistics: The study is being conducted at CHEO.

Project Lead: Dr. Mark Tremblay, Children's Hospital of Eastern Ontario

Overarching Project Objective: To promote and assess healthy active living among children and youth.

Specific Project Objectives: The objective of this project is to assist with conducting two, independent research studies. The purpose of the first study is to determine the proportion of 4-year-old children in Canada who meet the World Health Organization 24-hour Movement Guidelines. The purpose of the second objective is to track independent mobility and movement behaviours among children in Grades 3-6.

Background:
Study 1 is part of the SUNRISE International Surveillance Study of Movement Behaviours in Early Years (3-4 years). The purpose of the SUNRISE study is to collect international surveillance data using the new World Health Organization 24-hour integrated movement guidelines as benchmarks in a range of countries. The World Health Organization recommends that children aged 3-4 years accumulate at least 60 minutes of moderate-to-vigorous physical activity daily, engage in no more than 1 hour of screen time per day, and obtain 10-13 hours of good quality sleep each night. To date, there is no international data on the movement behaviours in the early years. Collecting international data from different countries will help the global community move towards preventing young children from developing obesity and ensure that they reach their developmental potential.

Study 2 is part of a multi-study, longitudinal project examining active transportation and independent mobility. Independent mobility refers to children's freedom to move around in public space without adult supervision, and is a major source of physical activity for children. This study aims to help inform the development of more effective evidence-based interventions on movement behaviours.

Research Project Components:
1. Conduct literature reviews on children's movement behaviours and independent mobility
2. Prepare Research Ethics Board application and approval for study
3. Recruit participants for studies, and assist with data collection, data entry, and data analysis
4. Assist with manuscript preparation for peer-review publication

Proposed Team: The student team will consist of 3-4 students from the MSc HTSP program. Ideally, the students will have some experience with conducting literature reviews, developing Research Ethics Board applications, experience working with children, and some knowledge of quantitative and qualitative methods.

Duration: The project will require 18-20 months to complete.

Logistics: Students will have the opportunity to work on both studies. Most project tasks will be conducted at the Children's Hospital of Eastern Ontario. Students will be required to travel to study recruitment sites (e.g., daycares, schools) with senior research members (car is not required). Weekly updates will be conducted via teleconference and/or in-person meetings.

Trauma-informed Physical Activity for Parenting Individuals
Supervisor: Dr. Francine Darroch

Research suggests individuals who experience multiple marginalizing circumstances (e.g., socio-economic inequity, domestic and structural violence, histories of trauma, addiction, or racism) may encounter barriers which preclude participation in physical activity. Important relationships between physical activity and positive health outcomes for individuals who have experienced trauma have been discovered. The literature suggests engaging in regular physical activity can decrease depression, anxiety, sleep disturbances, and other health conditions associated with post-traumatic stress disorder. Despite the widely accepted beneficial aspects of physical activity, inequitable access and uptake of physical activity persists. The application of trauma- and violence-informed practice to physical activity has been identified as a powerful tool to develop psychosocially appropriate physical activity programs and resources for individuals who experience barriers to participation. Through community-based participatory research, this project will aim to address the following objectives:

- Understand physical activity and wellness perspectives (e.g., barriers and enablers) of parenting individuals living in highly marginalized communities and how these perspectives are influenced by prevailing gender and socio-cultural norms;
- Determine how to co-create appropriate gender-based, trauma-and violence-informed, and culturally safe programs and resources to support the access and uptake of physical activity, social inclusion, pro-social behaviours, and overall well-being of highly marginalized parenting individuals; and
- Co-create and/or co-assess a multi-dimensional program of research leveraging TViPA to improve the QoL of parenting individuals who experience multiple marginalizing factors.

Three HSTP students will be involved in all aspects of the research and will garner skills to collaborate with community members, learn to respond to community identified needs, contribute to a scoping review, conduct focus groups and interviews, and support the development and evaluation of programming and resources. This work will focus on knowledge translation through the adaptation and creation of trauma informed resources.

Supervisor: Dr. Kristin Connor, Department of Health Sciences, Carleton University
Collaborators: Laurent Briollais (Lunenfeld-Tanenbaum Research Institute, Toronto), John RG Challis (Simon Fraser U, Vancouver), Sandra T. Davidge (U Edmonton, Edmonton), Claudio Delrieux (Universidad Nacional del Sur Argentina), Isabel Fortier (McGill U, Montreal), Daniel Goldowitz (UBC, Vancouver), Pablo Nepomnaschy (Simon Fraser U, Vancouver), Ashley Wazana (McGill U, Montreal)

Development of a tool to predict resiliency and risk for chronic diseases due to early life exposures

PROJECT SUMMARY

The Developmental Origins of Health and Disease (DOHaD)[1-3] is a framework to understand how environmental exposures in early life can shape the development and occurrence of chronic diseases throughout the lifecourse[4]. Yet, our ability to prevent poor health outcomes and enrich for resiliency remains severely limited because we do not have a complete list of exposures that predict risk and resiliency, studies have rarely captured the complexity of exposure-outcome relationships, and there has been limited dissemination of information to the people who can use this information.

Thus, for ultimate change in clinical practice and policy to ensure all individuals have a healthy start to life and healthy adult life, it is critical to have a comprehensive and validated tool to predict health trajectories. Such a tool should integrate social, environmental, and biomedical determinants of health, recognise the influence of our environments before conception, during pregnancy and postpartum to health across the lifecourse, inform about health risks, and identify factors that provide resiliency. Ultimately, the tool must also communicate this information in an understandable and accessible way, to support decision-making by the multiple stakeholders who can use and be informed by it.

APPROACH

The long-term goal of this project is to develop an application, grounded in DOHaD, to predict health risks and identify factors that provide resiliency. The initial specific aims of the HSTP project are to:
1. Use novel machine learning (ML) approaches to determine the major factors in early life that predict adult-onset disease pathways and influence resilience.
2. Develop a risk/resilience score based on the factors identified with ML, and test the performance of this score using data from existing pregnancy and birth cohorts.
3. Develop an application to inform future health risk/resiliency in an understandable way.

STUDENT REQUIREMENTS AND OUTPUTS

Interest in maternal-child/early life health, data analysis, and risk prediction are assets to the project. Students interested in this project *must* show evidence of a strong background biostatistics, bioinformatics, epidemiology, and/or artificial intelligence/machine learning. To assess your statistical analysis/machine learning experience, in your application indicate what software, packages, and methods you have used, and on what populations (these could be human or from animal models). Students must have excellent writing and communications skills, including critical review and analysis of scientific literature. Students lacking these skills/experiences should make a case for their suitability for the project despite these gaps, which may include current or planned analytical/computational courses during the HSTP programme. Work ethic, topic interest, and creativity to leverage the project beyond the primary aims are also desired. The number of students selected to work on the project (1-3) will be at the discretion of the supervisor based on the skills/experiences of interested applicants and project needs.

Over the course of the project (2020-2022) it is anticipated that the minimum outputs will be the production of at least one manuscript for publication and other KT outputs (e.g. infographics, brief reports) for dissemination to patients/families, the public, policymakers, and health care workers.

References

1. Barker, D.J. Developmental origins of adult health and disease. *J Epidemiol Community Health* **58**, 114-115 (2004).
2. Wadhwa, P.D., Buss, C., Entringer, S. & Swanson, J.M. Developmental origins of health and disease: brief history of the approach and current focus on epigenetic mechanisms. *Semin Reprod Med* **27**, 358-368 (2009).
3. Heindel, J.J.*, et al.* Developmental Origins of Health and Disease: Integrating Environmental Influences. *Endocrinology* **156**, 3416-3421 (2015).
4. Jacob, C.M., Baird, J., Barker, M., Cooper, C. & Hanson, M.A. The importance of a life-course approach to health: Chronic disease risk from preconception through adolescence and adulthood. White Paper. (ed. WHO) 1-41 (World Health Organisation, 2017).

Student Project Proposal (2020-2021)

Master of Science in Health: Science, Technology, and Policy (HSTP)

Carleton University, Ottawa, Canada

Proposed project:

Development of a predictive analytics model/proof of concept for predicting food safety events/incidents using multiple data sources for the Canadian Food Safety Information Network.

Objective:

Using historical CFIA laboratory data and other data sources (Provincial data, open source data, weather data etc.), develop a working methodology for predicting a food safety incident with PowerBI's capabilities for future CFSIN analytics development.

Background:

The Canadian Food Safety Information Network (CFSIN) aims to link FPT food safety authorities and food testing laboratories across Canada to share surveillance information and food safety data, resulting in better protection for Canadians from food safety risks. The development of the CFSIN will enable all food safety partners in Canada to benefit from this collective capacity. CFSIN will contribute directly to the following three long term outcomes:

1. A sustainable and proactive science-based approach to the identification of food safety risks/hazards enhanced by the analysis of pan-Canadian food safety data and information;
2. Strengthened response to the resolution of food safety issues and support for food safety investigations and events; and
3. An enhanced Canadian food safety system which supports international engagement and market access with trading partners.

The proposed CFSIN Platform solution will include multiple capabilities such as the Environmental Scanning tool, and the Intelligence tool. The CFSIN Environmental Scanning tool is designed to take articles from around the web related to the 3 business lines (Food, Plant, and Animal). Particular keywords are tagged within the article, allowing users to analyse global food safety trends. To do this effectively, the system requires a strong, comprehensive set of keywords and their appropriate synonyms (ontology). The Intelligence capability will provide users with the ability to analyze CFSIN data using sophisticated quantitative methods (e.g. statistics, descriptive and predictive data mining, simulation and optimization) to produce insights that traditional approaches to business intelligence (BI) such as query and reporting are unlikely to discover. The strategy is in line with the CFSIN analytics vision to provide food safety authorities with access to timely, consistent and quality multi-jurisdictional food safety information and to deliver analytics capabilities to enable increased ability to detect and prevent food safety issues.

Project Components:

1. Set up a series of workshops/meetings with stakeholders within CFIA to refine the problem statement. Based on the problem statement, work with the stakeholders to

identify multiple data sources/types of data which would help gain insight for food safety partners' during investigations;

2. Develop an optical character recognition tool to automate the verification of samples collected for the CFIA's food safety testing
3. Further refine the CFSIN's existing scanning ontology to increase the effectiveness of the Environmental Scanning (ES) tool's ability to tag articles using natural language processing.
4. Using historical CFIA laboratory data and other data sources (Provincial data, open source data, weather data etc.), develop data-driven solutions, automations or algorithms to inform decision makers on emerging food safety hazards using state of the art tools for food safety analytics.

Proposed Team:
The student team will consist of 3-4 students from the MSc HTSP program. Ideally, the students will have some experience in statistical methods, computer science, natural language processing, and science (microbiology and/or chemistry).

Duration:
The project will require 18-20 months to complete.

Logistics:
The project will be conducted and implemented at the Canadian Food Inspection Agency and would be managed by the Canadian Food Safety Information Network of Science Branch, Food Safety Science Directorate. Other CFIA groups or federal, provincial and territorial partners will be consulted as required.