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Beyond the Microscope: The Whole Human, The 2023 Canadian Undergraduate Conference on Healthcare

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Abstract
The following abstracts showcase remarkable research by undergraduate students on an array of topics in the research competition of the 2023 Canadian Undergraduate Conference on Healthcare held at Queen's University. This year's theme is Beyond the Microscope: The Whole Human, which investigates the relationship between the many elements of healthcare at the patient-physician level and beyond. Abstracts are grouped into oral presentations, followed by those for poster presentations. For more information, please visit: https://www.cucoh.com/.

Keywords: cucoh, research, cucoh 2023, undergraduate

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Conference Abstracts

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<u>**Oral Presentations**</u>

Prevalence, subtypes, and clinical implications of clonal hematopoiesis in cohorts of patients with solid cancer
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Introduction: Clonal hematopoiesis (CH) describes the age-related clonal expansion of somatically mutated hematopoietic stem cells and their mature progeny. CH-driven inflammation is associated with numerous comorbidities, and CH has been linked to poorer overall cancer survival due to tumour progression; a relationship that is likely heterogeneous across cancer types.
Methods: Our study will access clinical and genomic data from 10,782 patients with 37 cancer types from the International Cancer Genome Consortium and The Cancer Genome Atlas. We present initial data from 310 patients with thyroid or esophageal cancers. Donor matched blood sequences were processed with the GATK-Mutect2 somatic variant calling algorithm to detect variants involved with myeloid (M-CH) and lymphoid (L-CH) malignancies. Variants were reviewed for pathogenicity and CH status was used to derive clinical associations.
Results: CH was found in 20.5% (n=46/224) and 11.6% (n=10/86) of patients with thyroid and esophageal cancers, respectively. The distribution of M-CH and L-CH differed based on Fisher's exact test (p=0.0107), with M-CH more common in the esophageal (n=8/10) versus the thyroid cancer cohort (n=15/46). Age, tumour stage, and survival did not differ based on CH status in this initial sample.

Conclusion: CH is prevalent in thyroid and esophageal cancer patients, though the reason for differences in M-CH and L-CH is unknown and could be due to the underlying tumour biology or related treatment. With our bioinformatic pipeline, samples from other solid tumour types will be processed to elucidate the clinical implications of CH and guide its use as a biomarker in cancer treatment.

Investigating the stability and clustering of inhibitory receptors and their "don't eat me" ligands: A research study

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Introduction: Phagocytosis is an immunological process used to eliminate pathogens and malignant cells. To do so, phagocytes must decide which targets to engulf. This decision is facilitated, in part, by an integration of signals between phagocytic and inhibitory receptors which are spatiotemporally co-expressed on the plasma membrane of phagocytes. The binding of phagocytic receptors and their ligands leads to changes in the cytoskeleton that enable phagocytosis. In contrast, when inhibitory receptors engage their "Don't eat me" ligands on putative targets, phagocytosis is impaired. SIRPa is a canonical inhibitory receptor that contains four immunoreceptor tyrosine based inhibitory motifs (ITIMs) that are phosphorylated by Src family kinases upon engagement with CD47 on putative targets.

Methods: To understand whether the diffusion and organization of SIRPa in the plasma membrane contribute to its signal transduction, I have taken biochemical and imaging-based approaches which include western blotting, immunofluorescence imaging and single molecule tracking.

Results: My results show that SIRPa is not tethered to the actin cytoskeleton in macrophages, but CD47 is, at least partially, confined in its diffusion in tumor cells.

Conclusion: We show that SIRPa is not bound to actin and therefore could be predicted to diffuse laterally in the plasma membrane. Considering this, we hypothesize that SIRPa would cluster in a given area if its ligand, CD47, is confined or bound to the actin cytoskeleton at least occasionally. The results show that a significant fraction of CD47 in tumor cells is confined/immobile. The immobility of CD47 may provide a source for SIRPa to itself potentially bind and cluster. Western blotting and RT-PCR were conducted in knockdown cell lines to validate the interaction between CIC and its novel co-repressor, and uncover which downstream effector of the RTK pathway stabilizes CIC/YY1 interaction.

Results: We discovered that CIC forms a complex with ying-yang 1 (YY1) to co-repress ETV1/4/5. Importantly, we found that an ERK downstream effector p90RSK disrupts the interaction between CIC/YY1, and p90RSK inhibition stabilizes the CIC/YY1 co-repressor complex resulting in resensitization towards RTK/Ras/MEK/ERK inhibition.

Conclusion: These findings provide important insights into more effective therapeutic avenues such as using p90RSK inhibition to stabilize the CIC/YY1 co-repressor complex and resensitize towards RTK/Ras/ERK inhibition to prevent tumour proliferation in GBM.

Sphingolipids regulate acute myeloid leukemia sensitivity to venetoclax

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Introduction: Acute myeloid leukemia (AML) is a heterogeneous hematological malignancy in which chemotherapy often fails to eradicate disease-propagating leukemic stem cells (LSCs), resulting in disease relapse. We recently showed a role for sphingolipids in LSC function, but whether sphingolipids regulate drug response in LSCs is not known. Profiling of sphingolipids such as bioactive sphingosine-1-phosphate (S1P) in AML patient samples revealed a distinct sphingolipid distribution in primitive versus mature AML blasts. Moreover, sphingolipids and enzymes in the sphingolipid pathway, including SPHK1, may be predictive of overall AML patient survival, as seen through an 8-sphingolipid gene score. Venetoclax, which inhibits the anti-apoptotic protein B-cell lymphoma 2 (BCL-2), has shown some promise in targeting LSCs. However, it has been shown that more mature AML blasts are often resistant to venetoclax. Here, we hypothesize that venetoclax resistance may be linked to differential wiring of sphingolipid metabolism in primitive versus mature AML.

Methods: Our studies aim to determine whether sphingolipid modulation through inhibition of sphingosine kinase 1 (SPHK1) with PF-543 or delta 4-desaturase (DEGS1) with 4-HPR will synergize with venetoclax to target LSCs. We treated various mature and primitive AML cell lines with PF-543 or 4-HPR with or without venetoclax.

Results: Our preliminary data suggests that different AML cell lines have different sensitivity towards DEGS1 and SPHK1 inhibition. Furthermore, inhibiting DEGS1 or SPHK1 enhances venetoclax efficacy to cull stem-like AML cells.

Conclusion: Our work may provide precedence for a novel therapeutic avenue that targets LSCs via sphingolipid modulation to achieve AML remission.

Investigating the biological effects of sucralose signaling through GPR52 in the gut

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Introduction: Despite their widespread consumption, growing evidence raises concerns about the toxicity of non-nutritive sweeteners (NNSs) that may disrupt metabolic processes, thereby negatively impacting the gut microbiome and physiology including dysbiosis, inflammation, and cancer pathogenesis. We previously identified a novel receptor-mediated mechanism that can selectively detect the NNS sucralose through the activation of the orphan G-protein coupled receptor GPR52. Therefore, we hypothesize that sucralose signaling through GPR52 may contribute to regulating the effects of sucralose in the gut.

Methods: The human gut cell lines, HCT116 and Caco-2, were treated with sucralose prior to quantitatively assessing cell health and function using a panel of biochemical and viability assays. We will repeat this cellular phenotyping following the induction of inflammation with TNFα and knockdown of the GPR52 gene to characterize the pathogenic role of sucralose/GPR52 signaling.

Results: MTT cell viability assay revealed that the sucralose treatment was toxic to both cell lines at doses exceeding 1 mM, with a maximal cell viability loss of 45-50%. The related natural sugar sucrose was less toxic than sucralose in HCT116 and was not toxic in Caco2. Clonogenic growth (crystal violet), morphology (crystal violet), ROS (DCF), endogenous GPR52 and inflammatory gene expression (qPCR) will be used to complete the phenotyping panel.

Conclusion: These results suggest that sucralose is more toxic to gut cells than sucrose. The present study will further enhance our understanding of the biological relevance of sucralose/GPR52 signaling in the gut and help inform pharmacological approaches to design NNSs with reduced metabolic side effects.

MicroRNA-Based machine learning approach for kidney cancer discrimination

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Introduction: Kidney cancers are classified as benign oncocytomas or malignant renal cell carcinomas (RCC), composed of clear cell (ccRCC), chromophobe (chRCC), and papillary (papRCC) types. MicroRNAs (miRNAs) are small, regulatory RNAs that are frequently dysregulated in cancer-type specific patterns. To enable minimally invasive discrimination of kidney cancers, we explored a novel machine learning approach using serum miRNA data from patients with the four abovementioned cancers.

Methods: Following small RNA sequencing, serum miRNA data was preprocessed using relative frequency normalization and outlier detection. Existing similarities and differences in miRNA expression were visualized in MatLab software. Comparisons between papRCC and others, followed by ccRCC and others, and lastly chRCC and oncotytoma were performed using Molecular Feast software. The top 1% miRNA features from each comparison were identified to create a combined hierarchical classifier.

Results: Trained models discriminated between papRCC and other cancers with an accuracy of 89.5%. Accuracies for comparisons between ccRCC and the remaining types and chRCC and oncocytoma were 93.1% and 85.0%, respectively. Combined, the combined classifier achieved an accuracy of 98.7%. Our results identified candidate miRNA features which can be applied in computational models to discriminate between kidney cancers. However, issues in miRNA misannotation in public sequence repositories and low sample size should be addressed before using in clinical practice.

Conclusion: Computational models using serum miRNA expression data may be useful for discriminating kidney cancer types. Future investigations of our results will pave the way for better diagnostics and therapies.

<u>Poster Presentations</u>

Assessing instructor and staff approaches, method and conditions effective in supporting student mental health in academic environments: A research study

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Introduction: Proceeding the pandemic, students report higher demand for mental health resources and an increase in mental health disorders compared to prior years. Studies have proven that low mental health can lead to new or increased mental illness. Thus, the Champions for Mental Health (CMH) project was created at Queen's University to assess academic role models in promoting continual support for student wellness and mental health.
The first (2021-2022) CMH project showed conditions in which students identified academic role models to be supportive and promote student well-being. Analyzing the trends among the nominations, we will produce a detailed report on impactful mental health approaches, methods, and conditions.
Methods: Twenty/thirty previous nominees from the CMH project will be contacted via a questionnaire to identify methods, approaches and conditions that support students' mental health and well-being. These methods will be categorized from most to least influential, with case studies.
Results: As an ongoing project, we expect many nominees to have similar strategies in implementing mental health/wellness resources.
Conclusion: The research will be critical to understanding if Queen's University supports student well-being and the limitations restricting faculties from applying further resources. The study will identify key methods in providing mental health/wellness support, which future educators can apply through strategically implementing student well-being into academics.

Exploring US womxn's experiences with medication abortion: A large-scale qualitative study

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Introduction: The US Food and Drug Administration approved the use of mifepristone and misoprostol for early pregnancy termination in 2000 (updated in 2016). However, since the early 2000s, there have been many policies introduced at the state level that focus on restricting access to medication abortion. The purpose of this large-scale qualitative study is to: 1) Understand better womxn's experiences obtaining medication abortion care in the US; 2) Assess the barriers that US womxn face when accessing care; and 3) Identify avenues by which access to medication abortion care and information can be improved.
Methods: The term womxn includes women, trans-men, and gender non-binary folks. In order to investigate womxn's experiences obtaining medication abortion care, we are conducting in-depth interviews with approximately 1,000 individuals who used mifepristone/misoprostol on/after January 1, 2015 in any of the 50 states, Washington, DC, or the US territories. In these interviews we explore participants' backgrounds, reproductive health histories, experiences obtaining a medication abortion, and perspectives on areas for service delivery improvements in their respective state/territory. We are analyzing these data for contents and themes using inductive and deductive techniques.
Results: We have conducted seven interviews with womxn from Massachusetts, and data collection is ongoing.
Conclusion: By examining womxn's experiences obtaining abortion care we will be able to shed light on barriers and facilitators to access, identify systems and services in need of improvement, and create an evidence-base to help decision-makers and advocates working to expand access to timely and affordable medication abortion services.

Inequalities in lung cancer stage of cancer diagnosis in non-English/French speaking patients in Ontario, Canada: A research study

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Introduction: Lung and bronchus cancer is the most diagnosed cancer and cause of cancer death in Canada, accounting for ~25% of all cancer deaths. Over 50% of new lung cancer cases are diagnosed at late stages, where survival rates can be as low as 5%. Our previous work shows that sociodemographic and socioeconomic inequalities including age, area of origin, income, and access to primary care are associated with late-stage cancer diagnosis, but it is unclear whether patient language proficiency plays an important role.
Methods: We will use the Ontario Cancer Registry and Immigration Refugee and Citizenship Canada databases to create a retrospective cohort study of adult Ontario cancer patients diagnosed with incident lung cancer from 2010 to 2020. Using Poisson Regression with robust standard errors, we will discern the risk of cancer diagnosis at an early stage (Stage I, II) vs. late stage (Stage III, IV) between "English/French fluent" and "Non-English/French fluent" patients. The model will also include sex, age, postal code at the time of diagnosis, and number of primary care physician visits two years prior to diagnosis.
Expected results: We hypothesize that "Non-English/French fluent" patients are more likely to be diagnosed at a later stage of cancer due to lower healthcare contact and/or cancer awareness.
Conclusion: The findings of our study may identify disparities in cancer diagnosis in a previously uninvestigated demographic group, improving the delivery of targeted cancer screening programs and accessibility to primary health care services in underserved groups across Canada.

YY1 is a novel co-repressor of CIC in glioblastoma

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Introduction: Tumorigenesis of glioblastoma (GBM), the most aggressive primary brain tumor, is attributed to hyperactive RTK/Ras/ERK signaling. Capicua (CIC) is a transcriptional repressor that negatively regulates genes downstream of the RTK/Ras/ERK pathway. The best described CIC target genes are the oncogenic transcription factors ETV1/4/5. We found that hyperactive RTK signaling in GBM causes degradation of CIC, resulting in amplified ETV1/4/5 expression. Importantly, sustained MEK/ERK inhibition failed to stabilize CIC levels, suggesting that absence of CIC desensitizes cells to RTK/Ras/ERK inhibition. To discover novel therapeutic avenues aimed at CIC stabilization and sensitization of GBM towards RTK/Ras/ERK inhibitors, we need to understand how CIC functions. Since HMG-box transcriptional repressors, like CIC, typically form co-repressor complexes, we suspect CIC may work alongside a co-repressor.
Methods: To identify novel CIC co-repressors, we conducted mass spectrometry of DNA pull-down using an ETV5 biotinylated promoter construct with a known CIC repressor element. Western blotting and RT-PCR were conducted in knockdown cell lines to validate the interaction between CIC and its novel co-repressor, and uncover which downstream effector of the RTK pathway stabilizes CIC/YY1 interaction.
Results: We discovered that CIC forms a complex with ying-yang 1 (YY1) to co-repress ETV1/4/5. Importantly, we found that an ERK downstream effector p90RSK disrupts the interaction between CIC/YY1, and p90RSK inhibition stabilizes the CIC/YY1 co-repressor complex resulting in resensitization towards RTK/Ras/MEK/ERK inhibition.

Conclusion: These findings provide important insights into more effective therapeutic avenues such as using p90RSK inhibition to stabilize the CIC/YY1 co-repressor complex and resensitize towards RTK/Ras/ERK inhibition to prevent tumour proliferation in GBM.

Health warning labels for artificial ultraviolet radiation in Canada: A content analysis

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Introduction: Artificial ultraviolet (UV) radiation from indoor tanning (IT) increases skin cancer risk and poses a burden on the Canadian healthcare system. Provincial/territorial legislation requires health warning labels (HWLs) be posted in IT facilities. We sought to describe the content and appearance of IT HWLs to assess their design and inform future recommendations on how to effectively educate the public on IT risks.
Methods: A directed content analysis of Canadian IT HWLs from provinces and territories that require them as of June 2022 was conducted. Best practices for health and risk communication and relevant theoretical constructs, such as those from the Health Belief Model, were used to develop a 52-variable codebook. Two coders evaluated all labels independently with 96% agreement.
Results: Of the 31 IT HWLs assessed from the 11 provinces/territories requiring them, 71% of labels mentioned health risks, including skin cancer (n=22), skin burns (n=13), and eye risks (n=5). In comparison, 58% mentioned aesthetic risks, including premature aging (n=18). No labels addressed the benefits or barriers related to avoiding IT. Cues to action were uncommon (13% of labels). Only one label contained an image.
Conclusion: While most jurisdictions in Canada require IT HWLs, their content and design may not be informed by health and risk communication theory or best practices. Given the very limited use of graphic images and infrequent use of Health Belief Model constructs on the labels, their potential efficacy may be compromised. Collaboration between health communication experts and policy makers to redesign IT HWLs could potentially improve their effectiveness.

The IMPACT cross-sectional study: The socioeconomic experiences of US and non-US immigrants in Canada in the midst of the COVID-19 pandemic

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Introduction: COVID-19 exacerbated socioeconomic deficiencies within Canada's immigrant populations, yet the nature of these challenges between US and non-US immigrants is not well understood. Accordingly, the IMPACT study at the centre of this article included a Canadian national survey that compared key domains of life in US immigrants with non-US immigrants to assist policymakers.
Methods: Participants recruited from newcomer support services centers completed the IMPACT survey which assessed self-perceived impacts of COVID-19 on various socioeconomic markers. For each socioeconomic variable, we analyzed the experiential differences between US vs non-US immigrant subgroups. A chi-square analysis analyzesd the differences between subgroups (significance level α=0.05).
Results: On average, non-US immigrants in Canada were less likely to disclose their COVID-19 health status than their US-based counterparts due to financial concerns. Non-US immigrant subgroup elucidated a mentality of "making it on [one's]own" and a reluctance to seek out external resources. US immigrant were subject to a comparatively greater post-pandemic decrease in socioeconomic well-being, resulting in proportionally greater food and financial insecurities than non-US immigrants.
Conclusion: The study highlighted two key findings: (1) US immigrants faced a proportionally increased instability of their socioeconomic well-being; whilst (2) non-US immigrants faced greater social and intrapersonal barriers to external supports and experienced a greater incidence of COVID-19 infections, likely resulting from this cohorts reluctance to miss work on the basis of income generation. Government personnel, newcomer support centers, and researchers require evidence-based, demographically-targeted initiatives to aid the diverse needs of immigrants in in
the post-pandemic recovery period.

Public knowledge of button battery ingestions: A social media based cross-sectional analysis

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Introduction: Pediatric esophageal button battery (BB) ingestions are a devastating and preventable occurrence. Efforts to reduce esophageal BB ingestions have included primary preventative measures. It is integral to assess the public's knowledge about BB injuries to tailor future efforts.
Methods: Participants were notified about a crowdsourcing survey-based study through the SickKids Twitter and Instagram accounts. Data collection occurred over three months. The study included 5 demographic questions, 3 follow-up questions and 11 survey questions with 4 additional follow-up questions.
Results: There were 929 completed survey responses. The demographic distribution of study takers indicate that 68% were between 30-50 years old, 74.3% were Canadian, 75.7% had a university degree or equivalent, 82.6% had a yearly income of at least \$70,000 USD, and 37.7% identified as a healthcare worker. The survey found that 69.1% of participants knew that BBs could cause death if ingested and that this information was mostly learned in school (219/929, 23.6%). Only 7.8% (72/929) of participants were aware that the proper way to dispose of a dead BB was to cover it in tape; and only 10.1% (94/929) of participants knew to give children over 12 months old honey to eat after suspected BB ingestion. wrapping BBs in tape before discarding them. Unfortunately, since many BB ingestions are unwitnessed, efforts must still be directed at primary prevention and battery safety.
Conclusion: The current study provided insight for gaps in the public's understanding of BB injury including: the presentation of injury, the importance of honey after ingestion, and wrapping BBs in tape before discarding them. Unfortunately, since many BB ingestions are unwitnessed, efforts must still be directed at primary prevention and battery safety.

From symmetry to chaos and back: Understanding and imaging the mechanisms of neural repair after stroke

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Introduction: This review article outlines the current neuroimaging technologies and understanding of neurological repair after stroke, focusing on the mechanism of axonal sprouting. If stroke impairs anatomically segregated clusters of neurons directly proximal to the occlusion, how can function directly controlled by those neurons return in some patients?
Methods: After developing an understanding of various neuroimaging methods, a literature review is conducted on recent advances in post-stroke neuronal recovery.
Results: Connectivity is found to be more complex in the stroke versus healthy brain. This is the result of new connections that compensate for the destroyed pathways. New connections are disorganized and unstable, but they are effective and lead to functional recovery. Regions with a decrease in interhemispheric connectivity correlate with a direct behavioural deficit. Axonal sprouting is the best understood mechanism of repair, and has three types: Reactive, Reparative and Unbounded. This is shown in rodents and primates and is related to functional recovery. In humans, similar behaviour is observed, however the causal link to functional recovery has not yet been proven.
Conclusion: A critical period of enhanced neuroplasticity post-stroke has been found that enables improvement in function and structure even at late chronic stages. Connectivity in the brain after stroke was shown to be more structurally complex than in a healthy brain. The best understood mechanism in neural repair is axonal sprouting. The use of non-invasive imaging such as MRI both in animals and humans would provide invaluable information to patients recovering from this debilitating disease.

Health equity passport: A tool for medical resident training

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Introduction: Health equity is achieved when everyone can attain their full potential for health and well-being. Patients require their primary care provider to have a deeper understanding of the social determinants of health (SDOH) to provide the highest level of quality care. Family medicine residency programs are uniquely positioned to educate residents on the SDOH. However, barriers include variations in training sites, patient demographics, and access to referral.
Methods: A "Health Equity Passport for Medical Resident Training" is currently under development as a compact resource for first- and second-year family medicine residents. This evidence-based quality improvement training tool aims to improve health equity for vulnerable populations, ensure residents feel confident in providing quality care to these populations, and help advocate for more equitable medical practices. A literature review found limited results, further establishing the necessity of this project. A focus group identified the patient populations that medical residents at the Sunnybrook Health Sciences Centre had less exposure to. These four populations were: individuals with low socioeconomic status, immigrants & refugees, members of the LGBTQ2S+ community and members of the Indigenous community. Extensive research of best clinical practices was conducted to identify resources, training, and good practice recommendations for communication, screening, and treatment of these four patient populations.
Results: Finally, an initial prototype was developed with evidence-based learning objectives that encourage residents to seek opportunities and teaching points with their preceptors.
Conclusion: With further development, this passport has the potential to become a highly effective training tool for medical residents in Ontario and across Canada.

The impact of a primary care physiotherapist in a medical home setting

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Introduction: A primary care physiotherapist (PCP) was integrated into the medical home model in attempts to improve physician accessibility. To determine the impact of a PCP on medical home accessibility, the number of appointments per patient, referral rates, prescription rates and physician workload were analyzed.
Methods: A multi-method retrospective chart review was conducted on two samples. Sample one was composed of 200 patients seen for muscular/skeletal reasons by family physicians. Sample two was composed of 200 patients seen initially by a PCP. Patient charts were used to record the number of initial-visits, follow-ups, specialist referrals, prescriptions, and diagnostic-imaging referrals. The total quantity of each outcome was directly compared between samples.
Results: Sample one, seen by their family physician for muscular/skeletal reasons, resulted in 345 appointments compared to sample two, seen initially by the PCP, who resulted in 295 appointments. Patients seen by the PCP had 23% fewer orthopedic referrals, 31.5% fewer diagnostic-imaging referrals and 16.5% fewer prescriptions. When patients were seen by the PCP, the average number of appointments per patient decreased by 0.345 appointments for a total of 1.475 appointments per patient. 99/200 patients seen by the physician were referred to physiotherapy. 36/200 patients seen initially by the PCP were directed to their physician.
Conclusion: A PCP decreases the number of specialist referrals, diagnostic imaging referrals, prescriptions, and appointments needed for muscular/skeletal concerns. Directly booking with the PCP increases physician accessibility and decreases physician workload in a medical home setting.

Developing foundations to investigate oncogenesis in induced pluripotent stem cell derived human colonic organoids

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Introduction: Cystic fibrosis (CF) is an autosomal recessive disease caused by Cystic Fibrosis Transmembrane Conductance Regulator (*CFTR*) variants, which encodes for a chloride and bicarbonate anion channel in apical surfaces of luminal epithelia. CF lung disease accounts for morbidity and mortality and is characterized by infections and progressive loss of lung function. As the life expectancy of CF patients increase, pathologies including colorectal cancer are being determined. CFTR deficiency causes fluid homeostasis dysregulation, chronic inflammation, and barrier breakage in the intestinal mucosal membrane creating favourable conditions for oncogenesis development. To understand the mechanism of CFTR as a tumor suppressor, methodologies were developed to determine if CF-associated colorectal cancer can be studied in induced pluripotent stem cell (iPSC) derived human colonic organoids (HCOs).
Methods: iPSCs from a CF patient with the F508del mutation corrected via CRISPR gene editing, were differentiated to create non-CF HCOs. Proliferation was quantified by whole mount immunofluorescence staining of HCOs for Ki67. Tight junction permeability of HCOs was visualized using FITC-dextran fluorescence.
Results: iPSC derived HCOs expressed Ki67, and the colonic markers of CDX2 and ECAD. Ki67 quantification analysis using Volocity and Imaris software determined the percentage of proliferative nuclei in HCOs to be 5 % and 7 %, respectively. HCOs were impermeable to FITC-dextran fluorescence.
Conclusion: iPSCs were differentiated to non-CF HCOs. Methodologies were developed to quantify proliferative status and visualize HCO barrier integrity. Future directions include comparing phenotypes between CF HCOs and non-CF HCOs and conducting studies to investigate the mechanism underlying the link between CFTR deficiency and oncogenesis.

A systematic review of predictors of different vaping behaviours among adolescents, youth, and young adults

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Introduction: The rate of e-cigarette use among young people has increased at an alarming rate and there is rising concern regarding the long-term health effects of vaping. Understanding the processes of vaping initiation, escalation, and cessation is critical to addressing this emerging public health issue.
Methods: A systematic review was conducted of longitudinal studies to identify the predictors of different vaping behaviours among adolescents, youth, and young adults. PubMed, PsycINFO, IEEE Xplore, Google Scholar, and the Ontario Tobacco Research Unit library catalogue were systematically searched between June and September 2022. Besides including peer-reviewed English articles published since 2005, our own machine learning-based unpublished works were included. Studies that evaluated the health impacts of vaping, examined predictors of vaping susceptibility or risk perception, studies among the pregnant population, experimental and qualitative studies were excluded.
Results: A total of 112 studies were included in this final review, which were divided into 5 different categories- vaping initiation, escalation, continuation, cessation, and vaping prevalence studies. A total of 189 predictors were identified and categorized into 10 different groups- socio-economic, vaping-related, family and social influences, behavioural, psychosocial, policy-related, school-related, childhood and before birth, general health and interactions. We identified 21 most 'probable' predictors of vaping initiation, 19 for vaping prevalence, and 7 of vaping escalation.
Conclusion: These findings can guide the planning of targeted vaping prevention and intervention programs to provide upstream care to those that are susceptible to use as well as inform future researchers to investigate causal associations between predictors and outcomes.

Semaphorin 3A expression is decreased in oral potentially malignant disorders: A novel potential biomarker for stratifying the risk of progression to oral squamous cell carcinoma

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Introduction: The mainstay for assessing the risk of oral potentially malignant disorders (OPMDs) progressing to oral squamous cell carcinoma (OSCC) is tissue biopsy and histopathological evaluation via light microscopy, a difficult procedure prone to providing inaccurate diagnoses. [1] Thus, the identification of molecular biomarkers capable of stratifying OSCC transformation risk is critical. Certain semaphorins — a class of membrane-bound and secreted proteins — have been strongly implicated in the regulation of tumor progression. [2] This project compares the expression profiles of semaphorins in OPMDs with varying levels of progression risk.

Methods: The expression of semaphorins 3A, 3C, 3F, and 4D was first evaluated in a UM-SCC-1 cell line. Their colocalization with cortactin, an invadopodia marker, was also assessed. Based on these results, the expression of semaphorin 3A (SEMA3A) was measured with multiplex immunofluorescence and quantified via mean fluorescence intensity (MFI) using a semi-automated analysis algorithm.

Results: Cell Culture Analysis: SEMA3A had the highest expression in the UM-SCC-1 cell line compared to the other selected semaphorins.

Tissue Analysis: A significant decrease in the MFI of SEMA3A was demonstrated in progressing OPMDs compared to non-progressing OPMDs.

Discussion: Cell Culture Analysis: SEMA3A demonstrated a statistically significant colocalization with cortactin in the UM-SCC-1 cell line, which may imply a novel role in actin polymerization and cell motility.

Tissue Analysis: SEMA3A may have an inhibitory effect in the tumour microenvironment, which in turn prevents the formation of invadopodia.

Conclusion: Our findings highlight SEMA3A as a promising biomarker for determining the risk of OPMD progression to OSCC.

Conflicts of Interest
The author(s) declare that they have no conflict of interests.

Authors' Contributions
AZ: as a planning committee for the competition, assisted authors with their abstract submissions, drafted the conference abstract booklet, and gave final approval of the version to be published.
TAS: as a planning committee for the competition, assisted authors with their abstract submissions, drafted the conference abstract booklet, and gave final approval of the version to be published.
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AS: oversaw, provided guidance for submission of abstracts, and gave final approval of the version to be published.
VD: oversaw, provided guidance for submission of abstracts, and gave final approval of the version to be published.
BR: oversaw, provided guidance for submission of abstract, and gave final approval of the version to be published

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