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Abstract
The following abstracts highlight research by undergraduate students on a diverse array of topics related to healthcare presented during the research competition of the 2024 Canadian Undergraduate Conference on Healthcare held at Queen's University. This year's theme is Building Tomorrow's Healthcare: Technology and Innovation in Resilient Systems, which will explore advances in medical sciences that enhance patient care in a rapidly changing world. 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 2024, undergraduate

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Conference Abstracts

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Oral Presentations

Investigating the regulation of IL-36γ in response to various pathogen-associated molecular patterns in MCSF- and GMCSF-stimulated macrophages
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Introduction: Macrophages, integral components of the innate immune system, function as crucial sentinels against harmful pathogens, employing phagocytosis as their primary defence mechanism. Their characteristics can undergo profound alterations when exposed to macrophage colony-stimulating factor (M-CSF) or granulocyte-macrophage colony-stimulating factor (GM- CSF). Interleukin-36γ (IL-36γ) is a cytokine with recognized involvement in localized inflammatory responses. This study aims to characterize the expression pattern and potential roles of IL-36γ at the gene and protein levels under the influence of different stimulants in macrophages.
Methods: Differential gene analysis was performed on transcriptomic macrophage data to examine IL-36γ levels. Reverse Transcriptase Polymerase Chain Reaction and Quantitative PCR were used to quantify IL-36γ expression in macrophages exposed to different pathogen-associated molecular patterns (PAMPs). Flow cytometry was used to assess IL-36γ protein levels in various cell types and conditions.

Results: Macrophages cultured in GM-CSF for seven days exhibited notably higher IL-36γ levels compared to those cultured in M-CSF. Stimulation with lipopolysaccharides (LPS) significantly increased IL-36γ protein levels in primary macrophages. Macrophages cultivated in GM-CSF and those exposed to LPS also displayed increased IL-36γ gene expression. In contrast, stimulation with resiquimod led to a reduction in IL-36γ protein expression in macrophages.

Conclusion: These findings emphasize the flexibility of IL-36γ expression in macrophages, influenced by various stimuli. GM-CSF, in particular, proved to be a potent inducer, impacting both the IL-36γ gene and protein expression. Primary macrophages exhibited higher responsiveness than cell lines. This detailed analysis contributes significantly to our understanding of IL-36γ and its potential implications for immunity and inflammation.

Copper-based spin labelling of a membrane protein

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Introduction: Electron paramagnetic resonance (EPR) is a powerful structural biology technique that can investigate the structure and dynamics of complex biomolecular systems. The objective of this research is to adapt and extend the copper-based labeling method for Electron-Electron Resonance (DEER) spectroscopy to membrane proteins, which has never been done before. DEER measures distances between paramagnetic spin labels, like copper, offering precise structural insights, including conformational dynamics, protein oligomerization, and biomolecular interactions. This emerging copper-based system, depending on the chelation of a paramagnetic copper center by strategically placed histidine residues, enhances DEER distance measurement precision significantly.

Methods: Double dHis mutant proteins of our model membrane protein, H. walsbyi Bacteriorhodopsin (HwBR), were recombinantly expressed, solubilised in a detergent, purified, and incubated with copper (II)-nitrilotriacetic acid (Cu(II)-NTA). Cu2+ binding was assessed using continuous-wave electron paramagnetic resonance (CW-EPR), and distance between spin labels was measured via DEER spectroscopy.

Results: CW-EPR result confirmed the effective Cu(II)-NTA labeling of a membrane protein: we successfully labelled several transmembrane α-helices and a β-sheet of HwBR with Cu(II)-NTA. Our investigation revealed that the choice of detergent played a pivotal role in dictating the binding efficiency. Detergents characterized by suitably small micelle sizes facilitated Cu(II)-NTA binding, whereas those featuring larger micelle sizes impeded copper- binding processes.

Conclusion: This research is significant as it extends the more accurate copper-dependent DEER measurement to the structural studies of membrane proteins, which constitutes many potential therapeutical intervention targets but remain largely under-explored due to the challenge they presented to traditional structural techniques.

Co-delivery of a small molecule drug and therapeutic RNA for the treatment of glaucoma: A research study

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Introduction: Glaucoma is an eye disease affecting over 80 million individuals worldwide and is the second leading cause of blindness after cataracts. Current treatments involve therapeutic eye drops, which have a reduced efficacy due to their limited local bioavailability. Alternatively, gene delivery using lipid nanoparticles (LNPs) has shown promise in increasing therapeutic efficacy, however, its clinical translation has yet to be demonstrated. Here, we developed a novel synergistic treatment by co-delivering an anti-glaucoma drug and a siRNA therapeutic using LNPs.

Methods: Therapeutic-loaded LNPs were formulated using a microfluidic mixing method. Size and stability of LNPs were characterized using dynamic light scattering. Next, therapeutic encapsulation and lipid recovery of the LNPs were investigated using UV-based high- performance liquid chromatography (UV-HPLC), ribogreen and cholesterol assays. LNP uptake and siRNA delivery were characterized using luminescence knockdown in ovarian cancer cells (SKOV3). Finally, LNPs were incubated with immortalized human trabecular meshwork (iHTM) cells to quantify their in vitro therapeutic efficacy via actin density analysis.

Results: Therapeutic-loaded LNPs exhibit high siRNA encapsulation efficiency (>90%), and a size of 110nm. Additionally, they demonstrate successful uptake and gene knockdown in SKOV3 cells. Furthermore, actin filament degradation in iHTM cells is observed following treatment of therapeutic-loaded LNPs.

Conclusion: These optimized particles show uptake and delivery of the intended therapeutic in vitro, thus holding promise for improved glaucoma treatments. Future work will involve optimization using clinically relevant siRNA. Overall, this novel synergistic strategy for drug delivery can be applied to various disease models to enhance the efficacy of current therapeutics.

Using residual neural networks to predict the impact of genetic variants on transcription factor binding sites

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Introduction: Genetic variants in non-coding DNA sequences can influence gene expression by altering transcription factor (TF) binding sequences. Using chromatin immunoprecipitation sequencing (ChIP-seq and ChIP-exo) experiments to study the effect of DNA variants on TF binding can help uncover mechanisms of disease. While ChIP experiments remain resource dependent, machine learning serves as a promising candidate to predict variation in TF binding from genetic variants.

Methods: Residual neural networks from BPnet were trained on TF ChIP-seq/ChIP-exo data from mouse and human liver (TFs: HNF4A, ONECUT1, FOXA1, CEBPA) as well as mouse cardiomyocytes (TFs: GATA4, NKX2.5, TBX5). These models were evaluated and used to predict the impact on TF binding for 4956 regulatory variants in the Human Gene Mutation Database. Data from liver TFs were also used to evaluate cross-species predictions.

Results: BPnet predicted signal is highly correlated with empirical signal (Pearson correlation r = 0.68 - 0.81). Models successfully predicted significant changes in TF binding caused by experimentally validated cis-regulatory genetic variants. For example, a common variant associated with increased plasma triglyceride levels (rs651821 C>T) was previously reported to increase GATA binding at the APOA5 gene promoter, and this change was accurately predicted by the model. Potential new mechanisms of disease variants that require further validation were also identified.

Conclusion: Machine learning can estimate the impacts of genetic variants on TF binding profiles, even when models are built with data from other species. This can be used to prioritize genetic variants for experimental validation and discover new disease mechanisms.

Developing an interactive learning tool for advanced cardiovascular life support protocol

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Introduction: Advanced cardiovascular life support (ACLS) refers to a set of guidelines to provide urgent and emergent treatment for cardiac emergencies to improve patient outcomes. There is strong evidence that online interactive content can facilitate learning and engagement for students. This project introduces an innovative approach to ACLS education, developing a digital ACLS simulation to promote medical resident learning of relevant protocols. No similar resource was found in existing literature, lending to the potential contribution of a digital tool to the field of medical education.

Methods: A literature review was conducted on current ACLS guidelines to inform interactive content creation with MEDLINE [PubMED]. From this review, a decision tree based on validated care guidelines was derived, subsequently

guiding the development of the proposed digital application. Ultimately, a functional web-based prototype was constructed in HTML, JavaScript, and CSS frameworks.

Results: Our team developed an application that allowed users to input relevant information regarding a patient experiencing a cardiovascular emergency and output relevant care instructions based on established American Heart Association guidelines. Evidence-based descriptions were provided for each decision, referencing credible external resources for further learning.

Conclusion: We created an interactive ACLS application that has the potential to enhance learning of ACLS protocols. Next steps include testing this simulation with medical residents to establish whether a statistically significant benefit is observed. In the future, this project may inform the development and revision of similar digital content frameworks to enhance the delivery of medical education.

IL-23 drives the formation of tertiary lymphoid organs in a mouse model of progressive multiple sclerosis

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Introduction: Progressive multiple sclerosis (PMS) is a severe demyelinating autoimmune disease of the central nervous system (CNS). It is characterized by sustained disease progression and the continuous accumulation of neurological deficits. More importantly, current anti- inflammatory treatments are ineffective in treating PMS. This study aims to gain a greater understanding of the pathological mechanisms driving severe disease in PMS.

Methods: To induce CNS autoimmunity, mice were immunized with myelin oligodendrocyte glycoprotein. PMS was replicated in mice harbouring a transgenic immunoglobulin heavy chain, with wild-type (WT) mice serving as controls. Disease severity was assessed using semi- quantitative scoring. Tissues were harvested and analyzed using flow cytometry, immunofluorescence and immunohistochemistry to uncover pathological mechanisms.

Results: PMS mice developed severe disease with extensive lymphocyte infiltration into the CNS. Highly organized immune cell aggregates known as tertiary lymphoid organs (TLO) were found in the CNS of PMS mice. These TLOs were associated with regions of severe demyelination and neuronal atrophy. Interestingly, a high number of activated B-cells producing pro-inflammatory cytokine IL-23 were found within the TLOs. Depletion of IL-23 in PMS mice reduced disease severity and decreased the number of TLOs.

Conclusion: These findings suggest that TLOs play an important role in the severe disease associated with PMS. Furthermore, they highlight the significance of B-cell-derived IL-23 in the formation of these TLOs and, as a result, on disease severity. In a broader context, this study reveals novel pathogenic mechanisms in PMS that may serve as diagnostic or therapeutic targets in the future.

Beyond the surface: Evaluating surgical performance in deeper sites - Virtual reality surgical simulation

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Introduction: Virtual reality surgical simulators offer insights into surgical proficiency and psychomotor performance. Understanding skills at varying depths is crucial because deeper surgical sites often pose challenges in accessibility and precision. In this study, we assessed expert and trainee performance during simulated brain tumor resections at various depths. Our hypotheses were: (1) Performance scores of expert neurosurgeons remain consistent at varying depths, while (2) trainees' performance scores decline as they navigate into deeper, more challenging areas.

Methods: During a simulated subpial tumor resection, we evaluated 45 participants with the Intelligent Continuous Expertise Monitoring System (ICEMS), which captured metrics every 0.2 seconds, including ICEMS score, instrument tip separation, bleeding risk, tissue damage, aspirator force, and bipolar force. Average scores for each metric were calculated across depth intervals for four expertise levels: neurosurgeons, senior and junior trainees, and medical students. 3D modeling was performed using MATLAB, and regression analysis was carried out with SPSS.

Results: The analysis showed variations in trainee performance across depth intervals. Notably, neurosurgeons maintained their scores irrespective of depth and showcasing their expertise. Interestingly, as depth increased, medical students and

junior trainees improved their scores, while senior trainees declined. Among the metrics, neurosurgeons had the smallest instrument tip separation and medical students the largest.

Conclusion: This study, using virtual reality surgical simulators, offered invaluable insights into the critical role depth plays in surgical performance, revealing distinct variations across different expertise levels. This highlights the importance of mastering depth-related surgical skills, ensuring that upcoming surgeons master the complexities of performing deeper surgical sites.

The effectiveness of bubble blowing as a distraction method during insertion of an intravenous cannula in young children: A randomized controlled trial

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Introduction: Children benefit from distraction during minor painful procedures. Some anesthesiologists believe younger children do not benefit as much from passive distraction techniques (video-watching) and that active techniques are superior. This study compares two distraction techniques, video-watching and bubble-blowing, to reduce the pain and anxiety associated with intravenous (IV) cannula insertion for induction of anesthesia in young children.

Methods: This randomized controlled superiority trial assigned participants (2–5 years) into iPad video-watching or bubble-blowing groups before IV cannulation. Participants engaged with their distraction technique and underwent a standardized IV insertion procedure. Pain was rated using the Face Legs Activity Cry Consolability (FLACC) scale before, during, and after IV insertion. Anxiety was rated using the modified Yale Preoperative Anxiety – Short Form (mYPAS-SF) immediately following parental consent and before IV insertion.

Results: Data from 21 participants (9 females, median (IQR) age 3.8 [2.7 – 4.2] years) were available. Five participants (3 video-watching and 2 bubble-blowing) were converted to inhalation induction of anesthesia. The initial IV attempt was successful for 15 (88 %) participants (8 video-watching and 7 bubble-blowing). IV insertion FLACC scores were higher than baseline in 0/8 (0%) children with video-watching and 3/8 (38%) with bubble-blowing. IV insertion mYPAS-SF anxiety ratings were higher than baseline in 4/8 (50%) children with video-watching and 1/8 (13%) with bubble-blowing.

Conclusion: Collecting pain and anxiety scores during IV insertions in young children with passive (video-watching) or active (bubble-blowing) distraction is feasible and has the potential to demonstrate significant differences in these outcomes. Data collection is ongoing.

Development & validation of a model combining circulating tumour cell counts and quantitative ultrasound radiomics to predict neoadjuvant chemotherapy response in locally advanced breast cancer

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Background: Circulating tumour cells (CTCs) collected from women receiving neoadjuvant chemotherapy (NAC) for locally advanced breast cancer (LABC) may be correlated with clinical outcomes, including early recurrence-free, disease-free, and overall survival [1]. Previous studies have also demonstrated the efficacy of quantitative ultrasound (QUS) in predicting response to NAC in LABC [2,3]. However, an approach combining CTC and QUS data has not been investigated yet. Project objectives are to quantify CTCs in blood samples from LABC patients prior to commencing NAC. Comparing these baseline CTC values to QUS features would determine if any associations exist that could allow for creation of a machine learning-based model.

Methods: A retrospective study was conducted in patients with LABC who underwent an ultrasound and a liquid biopsy for CTC identification using the Epic Sciences platform (n = 20) [4]. Neoadjuvant chemotherapy response was determined using the Residual Cancer Burden (RCB) index of each patient (RCB-0/I = low risk & RCB-II/III = high risk) [5]. Both datasets were then used to create a model using three classification algorithms: Fisher's Linear Discriminant (FLD), k-nearest neighbour (KNN), and support vector machine (SVM).

Results: FLD had the best performance metrics for the combined QUS-CTC model, particularly in terms of accuracy. However, the best overall predictive model for LABC response to neoadjuvant chemotherapy belonged to a model that only incorporated QUS data, with the best performance metrics being observed in KNN.

Conclusions: QUS textural features combined with baseline CTC data can stratify the risk of neoadjuvant chemotherapy response in LABC.

Risk factors & resource utilization associated with pediatric bronchoscopy: A tertiary pediatric center retrospective review

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Introduction: After pediatric microlaryngoscopy & bronchoscopy (MLB), inpatient admission is standard practice but there is a lack of evidence in favor of it. Evaluating the post-operative course following pediatric MLBs is vital to ensure cost-efficiency in our resource-conscious healthcare system. This study aims to assess factors associated with post-operative complications after MLB and the need for post-operative admission.

Methods: Retrospective review of 200 MLBs (2019-2023). Cases with additional major procedures were excluded. Primary outcomes were post-operative complications: (1) respiratory events (laryngobronchospasm, desaturations $SpO_2 < 80\%$, airway interventions); (2) escalation of post-operative disposition; (3) length of inpatient stay. Relationships between patient demographics, indication for MLB, pediatric early warning system scores (PEWS), and complications were analyzed via logistic regression.

Results: 94 children were included (age 2.4±4.8 years). Indications for MLB included 61% (57/94) diagnostic, 22% (21/94) planned interventions, and 17% (16/94) surveillance. 87% (82/94) had planned admissions to constant observation step-down units, 11% (11/94) to intensive care units (ICU), and 1% (1/94) to ward. Complications, included 10% (9/94) prolonged inpatient-stay, 5% (5/94) respiratory events, and 2% (2/83) escalation of post-operative disposition. 50% (2/4) of respiratory complications occurred in post-anesthesia care unit (PACU) and 50% (2/4) in step-down unit. Logistic regression revealed that younger age (p=0.04), higher PEWS in PACU (p=0.04), and cardiovascular disease (CVD) (p=0.02) were significant risk factors of complications.

Conclusion: Younger age, higher PEWS scores in PACU, and CVD are risk factors for complications following MLBs. These findings may inform future investigations into optimizing post-operative inpatient bed allocation following pediatric MLBs.

Poster Presentations

Effects of alcohol, cannabis and stimulants on inflammasome activation in substance use disorder participants: A research study

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Introduction: Substance Use Disorder (SUD) is a mental condition that profoundly impacts brain function and behavior, leading to the inability to control substance consumption, including alcohol, cannabis, and stimulants. While previous research has established a connection between inflammasome activation and other neuropsychiatric disorders, the specific link between SUD and inflammasome activation remains unknown.

Methods: This study aims to assess the levels of IL-1β, IL-18, IL-1RI, and IL-1RII to quantify inflammasome activation in SUD patients with associations to alcohol, cannabis, and stimulant use. Utilizing the Luminex assay, inflammatory cytokine levels were measured, and substance use assessments, such as AUDIT, DUDIT, GAD-7, and PHQ-9, were employed to evaluate SUD severity. The Mann-Whitney test is utilized to determine significance, and Pearson r correlation is applied to assess the relationships between pairs of parameters.

Results: The results reveal a significant correlation between IL-1β and AUDIT scores (r = 0.31), suggesting the potential utility of IL-1β as a clinical biomarker for monitoring SUD. However, IL-18 did not demonstrate significant correlations with other substance use parameters such as DUDIT and AUDIT.

Conclusion: Further research is necessary to address limitations and explore the feasibility of employing IL-1β as a clinical biomarker.

The impact of biological sex and age on expression of negative regulators of inflammation and macrophage killing capacity

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Introduction: Age is a large risk factor for acquiring pneumonia; older adults with high levels of pro-inflammatory molecules (ex. TNF) are at particular risk. Biological sex is an additional risk factor for pneumonia where males are more likely to die of the disease and have higher TNF levels. Signalling through TNF receptors triggers negative regulator expression (these proteins attenuate the inflammatory response). Chronic exposure to TNF may decrease macrophage phagocytosis possibly due to negative regulator expression preventing the inflammation necessary for pathogen clearance.

Methods: To determine age and biological sex expression differences in negative regulators (A20, Dusp1, and Ptprs), RNA was extracted from whole lungs of young (3-6 months) and old (18+ months), male and female mice. cDNA was synthesized from the isolated RNA and used for real-time q-PCR to measure gene expression. To examine the effect of age, biological sex, and TNF on phagocytosis, macrophage killing assays will be conducted, with and without added TNF.

Results: We hypothesized negative regulator expression would be higher in old mice than young and increased in males, for both age groups. Results demonstrated age and biological sex had no significant effect on Dusp1 and Ptprs expression. However, for females, age had a significant effect on A20 expression. Our expected results include older male TNF exposed macrophages having decreased killing ability compared to young, female, and non-TNF exposed cells.

Conclusion: Investigating negative regulators and macrophage phagocytosis is important to understand molecular pathways that change with age, how they differ with biological sex, and how they influence infection.

The effect of socioeconomic status on PrEP use: A mediation analysis of HIV PrEP-related stigma

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Introduction: HIV incidence remains a public health concern for gay, bisexual, and other men who have sex with men (gbMSM). HIV pre-exposure prophylaxis (PrEP) is an efficacious preventative measure for HIV transmission with a rate reduction of 99%. PrEP uptake may be deterred by stigma surrounding PrEP and socioeconomic status (SES).

Methods: We explored the relationship between SES and PrEP uptake (1), the role PrEP-related stigma plays as a mediator in (1) by investigating the relationship between SES and PrEP-related stigma (2) and the relationship between PrEP-related stigma and PrEP uptake (3). Cross- sectional survey data were used. Surveys were distributed at sexual health clinics and social media from July to December of 2022 in Toronto, Hamilton, Ottawa, Vancouver, and Victoria. Participants were ≥19 years old, reported MSM sexual behaviour in the last 6 months, and self- reported negative HIV status. We conducted a descriptive analysis of the sample, logistic regressions to analyze the 3 relationships, and a mediation analysis of PrEP-related stigma in (1).

Results: n=1,120. Individuals with high SES were more likely to be PrEP users (OR 2.53) and less likely to experience PrEP-related stigma (OR 0.52) compared to those of low SES (OR 1; reference). Individuals with high PrEP-related stigma were less likely to be PrEP users (OR 0.39) compared to those with low PrEP-related stigma (OR 1; reference).

Conclusion: We identified notable and significant associations in all three objectives before and after adjusting for confounders. PrEP-related stigma was found to have a modest mediating effect on (1).

Genomic underpinnings of catecholaminergic polymorphic ventricular tachycardia: A research study

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Introduction: Catecholaminergic polymorphic ventricular tachycardia (CPVT) is an inherited disorder characterized by polymorphic or bidirectional ventricular tachycardia. Diagnosis is challenging as it is not distinguished by morphological alterations or electrocardiogram irregularities at rest, necessitating genetic testing in CPVT. This study aims to identify novel gene-disease associations for CPVT. Methods: Literature databases consulted included MEDLINE, Embase and Web of Science. Articles selected based on established inclusion and exclusion criteria were uploaded into NVivo to ascertain consistent results for novel gene associations for CPVT published since 2020.

Results: Novel gene-disease associations for CPVT included JUN, AGRN, and RPL3L. Prior gene associations include RYR2, CASQ2, TRDN, TECRL, CALM1, CALM2, CALM3, ANK2, KCNJ2, PKP2, and SCN5A. JUN encodes for junctin in the sarcoplasmic reticulum, which facilitates Ca 2+ accumulation. CASQ2 functions in Ca 2+ storage and is grappled with RYR2 for Ca 2+ transport via junctin. Additionally, RPL3L is a modifier gene for AGRN. RPL3L encodes ribosomal protein L3, and variants in this gene are associated with an increased risk of CPVT. It is expressed in the myocardium, but cardiac pathophysiology remains unknown. AGRN encodes agrin, which binds to cardiac a3 Na, K-ATPase, facilitating myocyte contraction. Suppression of agrin signalling increases cytoplasmic Na+ in cardiomyocytes, increasing contraction frequency.

Conclusion: JUN and AGRN / RPL3L appear to be promising candidate genes for CPVT, and these genes should be further scrutinized in functional studies to understand their pathophysiological mechanism. Cascade genetic testing will allow for early diagnosis and intervention, improving the prognosis for those affected by CPVT.

Patient attachment status and emergency department wait times in the Windsor-Essex Ontario Health Team: Changes from 2020 to 2022

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Introduction: Windsor Regional Hospital (WRH) has one of the highest emergency department (ED) wait times in Ontario and services 410,811 patients attributed to the Windsor-Essex Ontario Health Team (WEOHT). Primary care attachment patterns and ED utilization rates in the WEOHT were evaluated to understand ED use at WRH.

Methods: ED utilization, primary care attachment, mental health, and chronic disease datapoints were examined from the INSPIRE-PHC Primary Care Data Reports from 2020 and 2022. Data on ED wait times at WRH was accessed from the Canadian Institute for Health Information.

Results: ED wait time at WRH increased 79% (from 4.7 to 8.4 hours) between 2020 to 2022. Attachment rates to a primary care provider decreased by 5% while uncertainly attached patients, or those without regular access to a primary care provider, increased by 22%. Attached and uncertainly attached ED visitors decreased by 18% and 12% respectively. Attached and uncertainly attached patients showed a 3.8% and 6.3% increase in mental health diagnoses respectively. Uncertainly attached patients who had chronic obstructive pulmonary disease, congestive heart failure, and diabetes saw an overall increase of 24.1%.

Conclusion: Decreased ED visitors indicates that increased ED wait time at WRH is not solely attributed to patient volumes. An increase in complex care patients, especially those with chronic conditions and mental health diagnoses without regular access to a family physician, contribute to increased ED wait times. Improvement of attachment rates for those priority populations is an important focused strategy in addressing high ED use and wait times.

Understanding the influence of proton tunneling on protein dynamic activity and nucleic acid mutations:
A research study

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Introduction: In recent years, the discourse in biology has taken interest in proton tunnelling—a quantum jump between two equilibrium states, through a potential barrier, by a proton—and how it poses a threat to biological activity by either disrupting DNA sequences or interfering with enzyme kinetics. Exploring the mechanism of proton tunnelling may yield beneficial results that could have far-reaching consequences for our current models of genetic mutations and enzymatic disruptions.

Methods: This project explores the fundamental concepts of proton tunnelling, mainly the process in which a wave-particle can overcome a potential barrier. This is followed by an in-depth discussion around the fundamentals of the mechanism itself, including the tunnelling time and the Hartman Effect. This includes derivations of relevant formulae such as the WKB approximation, which provides an analytical solution for a wave function of a particle in a potential well. Models are generated in Python and Jupyter notebook to visualise the mechanism of proton tunnelling between two energy wells, which serves as a proxy for tunnelling between hydrogen bonds, applying the tunnelling to DNA and enzymes specifically. The models also reflect changes in mass for the subatomic particles such as is the case with isotopic differences. Further calculations on data convergence are conducted to determine model accuracy and realism.

Results: The simulations and accompanying tests showcase the expected outcomes of proton tunnelling between two potential wells, the results of which can be extrapolated to the same effect being observed in biologically contextual hydrogen bonds. Furthermore, the results signify the changes that occur in tunnelling shape and probability when the mass of the subatomic particles changes as in the case of isotopic differences.

Conclusion: Developing a cohesive understanding of proton tunnelling will prove fruitful in the application of quantum biology to a world seeking knowledge on genetic ailments and healthy living.

The effect of selective serotonin reuptake inhibitors on intestinal inflammation in dextran sodium sulphate:
A research study

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Introduction: Currently there is limited literature observing biochemical effects of selective serotonin reuptake inhibitors (SSRIs) within colitis models. The purpose of this preliminary study is to explore if Flouxetine, a commonly prescribed SSRI, attenuates the effect of colitis symptomology presented through utilization of dextran sodium suplhate (DSS) in an acute dosage mouse model.

Methods: C57BL/6 male mice were separated into six groups, characterized by fluoxetine-dose and 3% DSS administration (n=25). Vehicle dH2O (Naive), 5 mg/kg fluoxetine (Floux5) and 15 mg/kg fluoxetine (Floux15) were orally gavaged daily over three weeks. Approximately half of each group given 3% DSS ad libitum in the last five days of three weeks (Naive DSS, Floux5 DSS, and Floux 15 DSS). Clinical presentation (Disease Activity Index (DAI) and macroscopic score) and post-mortem proinflammatory cytokine profile (IL-1B and TNF-a), myeloperoxidase (MPO) activity, and histological score quanticolitis pathogenesis presence.

Results: Naive mice presented more severe visible disease than fluoxetine groups, difference not statistically significant. Cytokine markers for proinflammation amongst each 3% DSS group varied, difference not statistically significant. Despite no statistical significance there were general trends presented amongst the cytokine levels. Fluoxetine dosed mice had higher mean levels of IL-1B and TNF-a present in comparison to naive mic Fluox15 mice had the highest mean levels of IL-6. Fluoxetine 5 mg/kg dosed mice had the highest mean levels of MPO.

Conclusion: General trends of proinflammatory cytokines indicate continuing the study within a chronic mouse model system to better observe long-term colitis effect.

Health disparities experienced by East Asian manual workers during the COVID-19 pandemic: A literature review

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Introduction: Health disparities – including discrimination, marginalization, and stigmatization – escalated during the COVID-19 pandemic. Anti-Asian hate was especially prevalent, causing severe mental health concerns among the East-Asian population. Among those impacted, manual workers faced higher risks due to preexisting stereotypical views. Therefore, this review aims to investigate the types and scope of health disparities that East-Asian manual workers face and the corresponding repercussions.
Methods: 206 articles were extracted from PubMed, Cochrane, International Journal of Health Equity, and Omni Library. Author, year of publication, title, location, study purpose, methodology, subject characteristics, key findings, limitation, and conclusion were extracted and analyzed from 4 eligible articles. The Critical Appraisal Skills Programme checklist was utilized to appraise all included articles.
Results: Literature shows direct and vicarious discrimination, Sinophobia, racism, and violence, online and in-person, were experienced by East-Asian manual workers. These phenomena were frequently endured and witnessed by the East-Asian population, consequently instilling fear, stress, trauma, and mental health. Furthermore, data suggested that gender- and age-based prejudices were amplified as a result of anti-Asian discrimination, ultimately resulting in avoidance of physical activities and alteration in daily routines to minimize public exposure.
Conclusion: Health disparities encountered by East-Asian manual workers exhibit a high prevalence rate during the COVID-19 pandemic, worsening impacts of other types of social injustice and numerous social determinants of health. There remains a high demand for qualitative studies that evaluate the perspectives and attitudes of this demographic. Additionally, future research should explore preventative and protective protocols for the victims.

A single-cell molecular atlas of murine ventricular septation

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Introduction: Ventricular septal defects, the most common form of congenital heart disease, result from incomplete closure between the left and right ventricles. The process of septal development is known to be governed by an intricate genetic network, yet the cellular origin of the septum and its regulatory mechanisms remain to be further elucidated. Our preliminary analysis of murine heart single-cell RNA sequencing (scRNA-seq) data (GSE193346) reveals the specific but transient expression of LysM, traditionally recognized as a macrophage marker gene, in developing septal cells. Further, lineage tracing using LysM-Cre;Rosa26 TdTomato reporter mice showed that mature septal cells are developmentally originated from LysM-expressing cells in early embryonic hearts. To understand this developmental process, this study aims to build a molecular map of septal development at single-cell resolution.
Methods: LysM-lineage cells will be isolated at three developmental stages of LysM- Cre;Rosa26 TdTomato mice (E10.5, E16.5 and P7) by flow sorting and subject them to single-cell profiling of the transcriptome and epigenome (scRNA-seq and scATAC-seq).
Results: The resulting dataset will be bioinformatically analyzed with three overarching objectives. Firstly, this data will unveil distinct cell populations and gene expression patterns that may have been overlooked in traditional bulk analyses. Computational methods will be used to reconstruct the developmental trajectory of ventricular septation, identifying critical transition points and molecular regulators. Additionally, putative gene regulatory networks guiding ventricular septation will be constructed by incorporating cis-regulatory information.
Conclusion: By furthering our understanding of septal development, this study will advance the field of cardiac tissue regeneration and congenital heart defect treatment.

Factors affecting adherence to non-pharmacological therapies in Parkinson's disease: A narrative review

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Background: The rising adoption of non-pharmacological therapies among Parkinson's disease patients underscores the need to address challenges associated with adherence. While extensive research exists on adherence to pharmacological treatments, a notable gap exists in understanding and studying adherence patterns pertaining to non-pharmacological interventions for Parkinson's disease.
Methods: This narrative review aimed to extrapolate the factors that affect adherence to non- pharmacological therapies for people with Parkinson's disease. A search was performed in six electronic databases (PsycINFO, Medline, EMBASE, Scopus, CINAHL, Cochrane) with a 10- year restriction. Collaborative thematic analysis was conducted to extract common themes related to adherence.
Results: Of the 1257 studies imported for screening, only 47 studies met the defined inclusion and exclusion criteria and were retained for data extraction. The findings revealed four overarching themes: personal factors, program-design factors, disease-related factors, and system-related factors.
Conclusion: The findings provide a current understanding of the factors related to patient adherence to non-pharmacological therapies in Parkinson's disease and inform future initiatives for designing such interventions. It is recommended that future non-pharmacological therapies incorporate the identified themes to enhance patient adherence. Additionally, there is a clear necessity for the development of more effective tools to assess adherence to non-pharmacological therapies and further support comprehensive treatment evaluation.

Stop Cannabis Challenge: An evidence-based mobile application to support cannabis cessation

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Introduction: Over the past 5 years, changes in cannabis legislation has led to an increase in cannabis usage, cannabis-related problems, and hospitalization rates related to cannabis usage. In recent years, there has been a rapidly increasing amount of literature supporting the development of mobile applications to aid in substance use cessation, presenting a significant need for quality applications that can facilitate this process.
Methods: First, a systematic search was conducted on the cannabis cessation mobile applications currently available. The resulting mobile applications were evaluated using the Mobile App Rating Scale. This was supplemented with a literature review that examined any applications that were not captured in the initial search as well as any new research in the field of substance use cessation and mobile applications. The information was compiled and analyzed narratively. Based on the results, a mobile application titled the "Stop Cannabis Challenge" was developed in order to provide users a new evidence-based tool to support individuals in cannabis cessation attempts.
Results: The final prototype of the application is based on evidence-based research and a novel chatbot based approach to improve user engagement. The application has been published on the Apple App Store and the Google Play Store and is available for download today.
Conclusion: This mobile application is currently supporting individuals in their cannabis cessation attempts and will soon be tested in a randomized control trial to establish effectiveness. Overall, the application helps advocate for the use of mobile applications to aid in substance use cessation.

Pax2 mutant mice have increased susceptibility to FSGS and impaired podocyte regeneration

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Introduction: Focal segmental glomerulosclerosis (FSGS) is a form of chronic kidney disease characterized by the loss of specialized glomerular epithelial cells called podocytes. Pathogenic missense variants in PAX2 were previously reported in 4% of adults with FSGS. PAX2 is a transcription factor that regulates kidney development, but its expression persists in parietal epithelial cells which are postulated to be involved in podocyte regeneration.
Methods: Mice with a missense variant in Pax2 (Pax2-MV) were hypothesized to have impaired podocyte regeneration leading to increased susceptibility to FSGS than littermate wildtype controls. 8-week-old wildtype (n=10) and Pax2-MV (n=10) mice were treated with adriamycin to injure podocytes. Saline was given to a separate cohort (n=6 wildtype; n=6 Pax2 MV) for negative controls. Protein was isolated from glomeruli from each animal and analyzed by liquid chromatography-tandem mass spectrometry (LC-MS/MS). Resulting proteins were evaluated by gene ontology (GO) and signalling pathway enrichment analysis.
Results: GO terms involved in cell-cycle regulation, actin cytoskeleton organization and cytoskeletal protein binding were downregulated in Pax2-MV than wildtype vehicle-treated mice. This included 126 cell-cycle regulation and 50 cell-cell adhesion and cytoskeleton- dynamic downregulated pathways. Comparatively, Pax2-MV displayed FSGS while wildtype mice were resistant to disease after adriamycin. GO terms involved in metabolism, cell shape regulation, actin filament-based processes, and cell-junction assembly were downregulated in Pax2-MV than wildtype adriamycin-treated mice. This included 134 metabolic and 12 cell-cell adhesion and cytoskeleton-dynamic downregulated pathways.
Conclusion: Thus, Pax2-MV mice display abnormalities in cytoskeletal, cell-cycle and metabolism pathways which could reflect maladaptive podocyte repair, at baseline and after adriamycin-induced podocyte injury.

Depressive rumination from an evolutionary lens and its implications on modern mental health care:
A literature review

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Introduction: According to the DSM-5, inability to concentrate and rumination are symptoms central to depression. These symptoms contributed to the popular belief that depression causes impaired cognition. In attempting to treat depression, the intake of selective serotonin reuptake inhibitors (SSRI) is commonly suggested, despite controversies about the long-term efficacy of SSRIs in treating depression. Currently, there has been limited examination of depression from an evolutionary lens and its implications on diagnosis and treatment.
Methods: This systematic literature review will examine peer-reviewed journal articles from databases on the Analytical Rumination Hypothesis, long-term efficacy of SSRI and psychotherapy on treating depression.
Results: The review suggests that rumination may be an evolutionary adaptation. It directs individuals to shift their motivation and engage in analytical thinking to examine the causes and potential solutions to important, personally relevant problems. Moreover, it indicates the lack of long-term efficacy of SSRI on depression. As serotonin upregulates rumination, SSRIs do not appear to address the root causes of depression; discontinuation of SSRIs has also been shown to predict a relapse into depression. Although talk therapy may be more effective to engage with depressive ruminations, it is often inaccessible.
Conclusion: This review challenges the prominent view of depression as a disorder by the DSM- 5 and it calls into question the prominent use of SSRIs as a solution to resolve depressive symptoms and the lack of accessibility to psychotherapy. Future studies should continue to challenge the disorder narrative of depression and investigate how to effectively develop accessible and culturally sensitive psychotherapy options.

Sleep impacts daily autobiographical memory vividness, perspective, and perceptions of recency

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Introduction: Have you ever had a professor stress the importance of getting a good night's sleep before an exam to improve performance? While there has been an abundance of evidence to support this claim, most of the research conducted on sleep and memories has only been focused on laboratory-based stimuli. In contrast, little is known about how sleep impacts autobiographical memories, memories of everyday life events. In this study, we explore the influence of sleep on the emotionality, significance, perspective, recollection, and integration of recently formed autobiographical memories using HippoCamera, a memory recording app.

Methods: Throughout the two-week study, participants recorded two unique events a day using HippoCamera and noted their emotions and significance towards the event immediately after recording. Later, after a sleep or wake delay, participants retrieved their HippoCamera memory and answered questions regarding the contextualization, recall perspective, and the distance of memory, as well as their current emotions and significance.

Results: Preliminary data has shown that participants felt that a memory was closer in time and easier to recall after sleep delays, and that autobiographical memory retrieval in an owns eyes perspective were more likely after a sleep delay than a wake delay, demonstrating how these memories are consolidated during sleep verses wake.

Conclusion: This study aims to contribute insights to an underexplored domain and enhance the understanding of the impact of sleep. The significance of comprehending the impact of sleep on the consolidation of autobiographical memory cannot be overstated, given its potential implications for memory-related disorders.

Advancing the comprehensive antibiotic resistance database through the addition of anti-fungal resistance mechanisms

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Introduction: Antimicrobial resistance (AMR) is a growing public health threat. The World Health Organization has recently declared fungal pathogens an imminent threat to human health, with only four drug classes of antifungal medicine currently available. 1 My goal was to expand the Comprehensive Antibiotic Resistance Database (CARD) 2, which integrates the Antibiotic Resistance Ontology, with curated AMR gene (ARG) sequences and resistance-conferring mutations to provide an informatics framework for anti-fungal resistome annotation and interpretation for sequenced infections.

Methods: I performed a literature review to determine the antifungal drug classes that are clinically recognized. A requirement was that each antifungal needed to be cross-referenced with PubChem, a database maintained by the National Center of Biotechnology Information for all chemical molecules, and associated with a valid PubChem ID. 3 Furthermore, for posterity, each gene must have been published in a peer-reviewed scientific journal with the DNA sequence accessible through GenBank. Strong experimental proof of a minimum inhibitory concentration above controls was also required.

Results: The expansion of CARD now includes up-to-date information about six new drug classes, seventeen new drugs, twelve new gene families, nineteen new ARGs, and three new bioinformatics detection models for sequence analysis.

Conclusion: The project highlights the importance of standardizing data via the organization of ontology and knowledge of AMR mechanisms, addressing the imminent public health crisis posed by antifungal resistance. I continue working with the McArthur Lab to develop software for fungal resistome analysis and prediction for all antifungal gene families, using the newly expanded CARD as a reference.

Evaluating OSMS and shoulder immobilization for larynx cancer patients

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Introduction: Cancer treatment has progressed exponentially in the past century, with the availability of chemotherapy, radiation therapy, immunotherapy, and surgery coming to light. Treatment planning, patient positioning, and monitoring are

critical elements that each play a role in ensuring a high degree of precision in targeting cancerous cells while minimizing radiation to healthy, surrounding regions. Immobilization devices play an important role in both interfractional and intrafractional movement and can vary from thermoplastic masks, shoulder depression systems, vacuum bags, or body rests. However, the optimal technique for maximizing dose accuracy while minimizing movement is contingent upon the section of the body evaluated. Our research aims to evaluate the accuracy and effectiveness of the shoulder cantilever depression system for reduction in interfractional and intrafractional shoulder movement in intensity-modulated radiation therapy (IMRT) for larynx cancer patients.

Methods: We aim to evaluate the feasibility of SGRT techniques such as optical surface monitoring systems (OSMS) for patient setup reproducibility across treatments. Through the use of OSMS, a clavicle-based ROI will be tracked to measure 6D deviations in positioning. These values will be compared relative to shifts between planning computed tomography (CT) and treatment day cone-beam CT (CBCT) scans.

Results: Two larynx patients have been studied thus far, with little consistency in the pattern of shifts with regard to the gantry angle and no indication of a time trend.

Conclusion: This study has only just begun, but we have high hopes for enhancing our understanding of body immobilization in radiation therapy and potentially improving dose accuracies in treatment.

Deconstructing hierarchical bullying in senior high boarding schools in Ghana

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Introduction: Bullying is a social behaviour that instigates psychological and/or physical harm to others. In Ghana, bullying is a growing issue of concern because it is ingrained in the senior high school (SHS) culture.

Methods: The study was a retrospective observational one which required volunteer participants to fill out an online survey

Results: Male students in SHS 1 and SHS 2 who were in mixed-sex schools were bullied more predominantly than their counterparts in single-sex schools. They also bullied others in greater proportion in SHS 3. Female students in SHS 2 who were in single-sex schools were more considerably bullied than those in mixed-sex schools. Furthermore, bullying was independent of age group. Although not statistically significant, there is a trend of males who are popular being bullied very often in SHS 1 and SHS 2 while males who are "not popular" bully others "very often" when they are in SHS 2 and SHS 3. The high incidence of bullying in males in mixed-sex schools is suggestive of the tendency to exhibit aggression which is recorded in the literature to have a seductive influence on females and the opposite is true for females. The display of bullying, where popular people are bullied "very often" and unpopular people bully others "very often" suggests that there is a dominance-hierarchical underpinning to bullying.

Conclusion: Bullying undermines the telos of senior high education, which is rooted in discipline and knowledge acquisition. Mapping out the structure of bullying will help eradicate this ingrained practice from our schools.

A health equity-focused interactive patient simulation for medical students

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Introduction: Patient experiences are essential for medical students to develop comfort caring for equity-deserving patient populations. However, real-world interactions are often challenging to facilitate. A health equity-focused interactive patient simulation offers a valuable alternative, allowing students to develop critical skills and empathy in a supportive environment.

Methods: An initial literature search was completed using the PubMed and the Web of Science databases. The keywords searched included "Simulation&", "Healthy Equity", "Learners" and "Medical Students" to investigate the current literature on available simulations. The results were analyzed narratively to highlight how health equity- focused simulations are currently being used for learners in different areas of healthcare. A needs assessment evaluated the existing resources and tools within Ontario medical schools aimed at advancing health equity, providing critical insights for designing an effective and informed simulation.

Results: An intervention plan was created and highlights the overarching goals of the simulation. The "Health Equity-Focused Interactive Patient Simulation for Medical Students" aims to help medical students gain experience, knowledge, and skills related to caring for equity-deserving patient populations through simulated patient interactions. The simulation will guide students through the process of providing quality care to a diverse array of patients through interactive patient dialogues and informational evidence-based prompts.

Conclusion: The simulation is currently in the development stages and has the potential to provide medical students with valuable experiences and skills related to caring for equity-deserving patient populations. The simulation will encourage medical students to approach patients with empathy and advocate for health equity.

Determining the impact of a high glucose beverage and food-related stress on resting blood flow pattern

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Introduction: Different levels of stress related to perceptions of high sugar beverage consumption may impact the influence of hyperglycemia on baseline blood flow pattern, specifically the oscillatory shear index (OSI), in food-stress-prone women. An elevated OSI can negatively influence vascular function. Objective is to determine whether the impact of a high sugar milkshake on OSI is different when the milkshake is consumed under a condition designed to elicit stress.
Methods: Twenty-five young, healthy, non-smoking women, identified via questionnaire to be high in food-related stress will participate in three conditions: 1) high perceived calorie/fat/sugar (HP), 2) low perceived calorie/fat/sugar (LP), 3) and water condition (control). Brachial artery antegrade blood velocity, retrograde blood velocity, and diameter will be measured with duplex ultrasound pre beverage consumption and 54 minutes and 84 minutes post. Shear rate will be calculated as antegrade or retrograde velocity/diameter.
Results: We expect that the OSI before beverage consumption (pre) will not differ between the three conditions. However, post beverage consumption, we expect that the OSI will be greater than pre in the HP and LP conditions and greater in HP vs. the LP condition.
Conclusion: This study will provide insight regarding the interaction between feelings about food and the physiological impact of food, specifically a potentially deleterious shear stress pattern, in food-stress-prone women.

Investigating the effects of dietary flaxseed and flaxseed oil on intestinal health in lipopolysaccharide-challenged male C57Bl/6 mice: A research study

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Introduction: Lipopolysaccharide (LPS) is a molecule on the outer membrane of gram-negative bacteria, capable of triggering an immune response when outside the gut. It effects the gastrointestinal (GI) tract structures, such as the ileum, reducing goblet cell density and mucous content. This study explores LPS's effects on the GI tract and the potential mitigating role of dietary flaxseed (FS) or flaxseed oil (FO). FS contains α-linolenic acid, which converts to EPA and DHA. This study aims to reveal the protective effects of FS and FO against LPS challenge.
Methods: 72 male C57Bl/6 mice were divided into three diet groups: basal diet (BD), BD with 10% FS, and BD with FO, which they consumed for three weeks. Mice were intraperitoneally injected with 1 mg/kg LPS or saline. Euthanasia followed 24 hours post-injection, and ileum cross-sections were stained for analysis. ImageJ software was used for histological analysis of mucus content as well as villi height.
Results: Two-way ANOVA showed a significant treatment effect ($p=0.0002$) on ileum mucus content, with no diet effect ($p>0.05$). LPS increased mucus production. Significant differences were observed between FO diet groups ($p=0.0225$) (Fig 1). However, diet and treatment did not affect villi height or goblet cell counts.

Cellular fate, inflammation and tissue integrity in the ischemic cortex following middle cerebral artery occlusion in rats: Phase 1

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Introduction: This study aims to investigate cellular fate following ischemic stroke in rats. This research seeks to understand cellular responses within diffusion-weighted imaging (DWI)- restricted regions and their potential for long-term survival.

Methods: We will use a transient middle cerebral artery occlusion model in rats, acquiring serial DWI images. Subsequent reperfusion will occur upon occlusion filament removal, and imaging will continue. Rats will be post-operatively recovered, and subgroups will be sacrificed at 24 hours, 72 hours, and seven days post-stroke. Tissue samples will undergo 2,3,5-triphenyl tetrazolium staining for confirmation of tissue death and will then be spatially registered to DWI images.

Projected Results: Based on previous research (Ma et al., 2019; Chamorro et al., 2021), results may reveal varying degrees of tissue preservation and cellular responses in the DWI restriction reversal regions at different time points. The preliminary results could suggest that acute and subacute phases involve distinct cellular processes, with potential differences in cell populations such as neurons and astrocytes.

Significance: This study will provide crucial insights into cellular processes in DWI-restricted areas post-stroke, with potential implications for novel stroke recovery strategies. Findings of this study will be compared with non-human primate (NHP) models of ischemic stroke to offer insight into species-specific cellular differences.

Conclusion: Using the findings from Phase 1, we will quantitatively assess cell populations in distinct cortical regions in Phase 2. In Phase 3, we will explore molecular pathways associated with neuroprotection, notably examining the role of heat shock protein 70 (Hsp70) and its potential impact on recovery mechanisms. These subsequent phases will contribute to a comprehensive investigation of cellular and molecular aspects of post-stroke recovery.

Effect of elevated carbon dioxide (CO2) on Eruca vesicaria defence and Eruca vesicaria-Myzus persicae interactions

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Introduction: Elevated levels of atmospheric carbon dioxide (CO2) as a result of anthropogenic activity have been found to influence a plethora of abiotic and biotic ecological components, impacting the interactions of herbivores with producers. Few studies have examined the effect of elevated CO2 on the interaction between Eruca vesicaria and Myzus persicae. As a result, we asked whether elevated CO2 (eCO2) exposure influences the defence response of 4-week-old arugula and what the subsequent effect is on its interaction with aphids. Specifically, we investigated the impact of eCO2 on aphid populations placed on arugula plants and on arugula leaf size for both aphid and no aphid conditions.

Methods: Six domes were created, two were pulsed with low CO2 (~6000 ppm), administered in the form of dry ice, two were pulsed with high CO2 (~62000 ppm), and the final two served as ambient CO2 controls.

Results: The final mean aphid population was found to be significantly different between the different CO2 levels, which indicates that eCO$_2$ has an influence on aphid population. The interaction between CO2 treatment and day was also found to have a significant effect on mean aphid growth. This implies that over time, eCO2 is associated with an increase in aphid population. Additionally, CO2 treatment and aphid presence played an insignificant role on mean final leaf size, indicating that CO$_2$ and aphids are not significantly influential factors on leaf size.

Conclusion: We propose that this is due to the suppression of JA-defence pathways and the upregulation of SA-defence pathways.

Sharing science made simple: Exploring the quality and readability of published lay summaries across three cohorts

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Introduction: Scientific journals remain the predominant platform for communicating research findings. However, their content is often not comprehensible to general audiences. Lay summaries are concise outlines of key information in scientific articles that leverage accessible writing techniques to communicate research in a more digestible format. This study examined the overall quality and readability of published lay summaries to support increased science communication efforts in the field.

Methods: 200 lay summaries were obtained from four scientific journals: eLife, PLOS Medicine, Proceedings of the National Academy of Science (PNAS), and the Journal of Hepatology. Over 900 students from three cohorts of the Life Sciences 2AA3 course at McMaster University were recruited as raters to evaluate each summary using a rubric developed

by Dr. Katie Moisse. The Flesch Reading Ease formula was used to determine the readability of the highest and lowest scoring summaries from each journal.

Results: eLife and the Journal of Hepatology had the highest and lowest mean scores of 15.6 and 11.7 out of 20, respectively, for overall quality. Significant differences were found in accuracy and accessibility across all journals (p<0.0001). eLife had the highest scoring lay summary for readability.

Conclusion: The difference in overall quality across journals and lack of consistent scoring in both accuracy, accessibility, and readability, indicate that there is considerable variance in the quality of lay summaries across journals. Findings suggest a need for improved lay summary guidelines for journals and can be shared with the greater science community to inform best practices for science communication.

Secondary solute transport pathways of the golgi apparatus mediated by NHE7

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Introduction: The Golgi apparatus is crucial for glycosylation, a key process for modifying transmembrane proteins. The Golgi's optimal function relies on an acidic pH in the trans-Golgi network (TGN). This pH is maintained through various factors, including the activity of the V-ATPase H^+ pump, buffering capacity, and the rate of hydrogen ion (H^+) leakage, which may involve the Na^+-H^+ exchanger, NHE7. However, the physiological role of NHE7 remains unclear. Additionally, glycosylation reactions in the TGN release phosphate groups (P_i), which must be expelled to maintain acidity, but this mechanism also remains unknown. We propose that the Na^+ gradient generated by NHE7 facilitates P_i extrusion.

Methods: We developed a method to measure TGN pH using an mRuby-pHluorin probe in wild-type and NHE7 knockout U2OS cell lines. We also identified TGN-localized Na^+-P_i transporters by analyzing candidate genes within SLC17A and SLC20A families through qPCR. Results/Conclusion: Preliminary findings suggest that NHE7 deletions lead to TGN alkalinization. This is contrary to the expected acidification, supporting the hypothesis that the TGN-to-cytosol Na^+ gradient, generated by NHE7, is necessary for the extrusion of P_i, allowing for organellar pH maintenance.

Significance: The ability for tumors to avoid immune destruction is a hallmark of cancer. This is accomplished through the upregulation of components in their glycocalyx, a network of membrane-bound polysaccharides and glycosylated proteins. To support ongoing glycosylation, P_i export from the TGN must be increased. By understanding the mechanisms of P_i extrusion, this study may reveal new therapeutic targets in various malignancies.

Using natural language processing to predict the transmission pathways of antimicrobial resistance genes through a "Confusogram"

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Introduction: Antimicrobial resistance (AMR) is a growing global public health threat that degrades our ability to treat bacterial infections. By adopting a One-Health perspective, Canada has recognized that as the human population expands, the health of humans, animals, and ecosystems are closely interlinked through the spread of AMR.

Methods: Previous MSc work in the McArthur lab used machine learning to create a dataset composed of 204,094 AMR-associated publications worldwide, as available in PubMed. This dataset includes information identifying relationships between antibiotic resistant genes (ARGs) and other epidemiology terms (i.e., farm, chicken, etc.). Using various similarity metrics (ex. Jaccard, Bray-Curtis, gene-overlap, and co-occurrence affinity, I quantified the association among each pair of terms.

Results: Using the top 10 highest scores, the result is an AMR "confusogram" network, which for the first time, displays the different pathways of transmission of ARGs among environments, nations, and pathogens. For example, the term "poultry drumstick" is connected to "farm" which is connected to "hospital" via shared ARGs; this illustrates the flow of ARG transmission. My project uses natural language processing (NLP) techniques to extract and analyze the transmission of ARGs among different environments.

Conclusion: Overall, this work incorporates an interdisciplinary analysis of data across scientific (NLP, genetics of AMR), sociopolitical (adjusting for different national approaches to antibiotic use or food production), and environmental (climate,

wastewater fate) perspectives; such information can be useful in providing qualitative risk assessments of various ARGs and a first global model of ARG transmission.

Influences by fetal trophoblast cells on decidual leukocyte localization and immune tolerance in pregnancy: A research study

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Introduction: In pregnancy, fetal expression of paternal genetic material risks rejection by maternal immunity. Fetal rejection is linked to clinical complications including growth restriction and preeclampsia, potentiating fetal and maternal morbidities and mortality. Successful pregnancy requires changes in maternal leukocyte phenotype and localization at the implantation site to promote tolerance. While previous studies have attributed the establishment of tolerance mainly to decidual stromal cell signalling and hormonal regulation, recent studies suggest that invading fetal trophoblast cells may contribute to their own tolerance. We aim to examine the role played by trophoblast cells in maternal leukocyte localization at the implantation site.
Methods: We used the murine pseudo-pregnant bead-induced deciduoma (BID) model to generate murine implantation sites without embryos. Using single-cell RNA sequencing (scRNA-seq), multiparametric flow cytometry (FACS), and immunohistochemistry, we examined differential expression and abundance and localization of leukocytes in embryo vs BID implantation tissues.
Results: Preliminary scRNAseq data revealed differential phenotypes in macrophage and uterine Natural Killer (uNK) cell populations. FACS testing on embryo implantation sites based on differentially expressed markers has identified 5 distinct myeloid populations and revealed high numbers of M2-polarized macrophages in embryo sites. Concurrent IHC analysis corroborated this finding and further revealed that M2 polarization is less prevalent in BID sites.

Conclusion: Transcriptomic, cytometric, and histological comparisons of embryo versus BID may hint toward the role played by trophoblast cells in adapting leukocyte localization at the implantation site. Further elucidation of the molecular mechanisms of fetal-maternal crosstalk will contribute to alleviating immune-driven pregnancy disorders.

Critical care resource access for obstetric patients in Ontario: A province-wide study

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Introduction: Critical illness in pregnant patients requires advanced critical care support and interventions, but critical care utilization varies greatly across Canada. This study aimed to assess the availability of and access to critical care resources in obstetric units across Ontario.
Methods: An online survey was sent by email to physician and/or nurse leaders of active obstetric facilities in Ontario. The survey consisted of 14 questions about the unit procedures for accessing critical care and support services available at the hospital. Data were analyzed descriptively, with comparison across ruralities defined using Index of Remoteness.
Results: We received responses from 44 (55%) of the 80 obstetric units in Ontario. Only 18 sites (41%) had access to an ICU in-house, and of the 26 (59%) units who accessed ICUs at other hospitals, 24 (92%) transported by ambulance and 17 (65%) by helicopter. Most sites would rely on Anesthesia (80%) or Internal/Obstetric Medicine (64%) for support while awaiting transfer. Transport was over 1 hour or of distance over 75 km for 62% of transferring units, with median transfer time of 65 minutes. Urban centres had more access to specialty support services than rural centres (Fig 1), as well as greater availability of laboratory tests and imaging (Fig 2). In some rural centres, specialty support services were entirely unavailable.

Conclusion: Obstetric units in Ontario have variable access to critical care services, with particular support limitations in rural areas. Areas for potential improvement include early identification of critical illness, early supportive care, and optimized inter-facility transport.

Investigating how phosphorylation of the SLX4 MBR influences SAP domain folding

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Introduction: Structure-selective endonucleases remove branched DNA structures that can compromise genome stability. One example is the SMX tri-nuclease, composed of SLX1-SLX4, MUS81-EME1, and XPF-ERCC1. A key question in our field is how the SMX complex assembles. Our lab recently showed that CDK1-cyclin B phosphorylates the SLX4 scaffold at three consensus sites in the MUS81-binding region (MBR): T1544, T1561, and T1571. These phosphorylations promote folding of a canonical SAP motif, which underpins a high affinity interaction with MUS81-EME1. My research aims to determine whether phosphorylation of residue T1571 alone drives folding of the SAP domain.
Methods: Mutant SLX4 MBR proteins were generated by Thr-to-Ala substitutions at T1571 and T1544/T1561. The recombinant proteins were expressed in bacteria and purified through a multi- column fast performance liquid chromatography scheme, followed by in vitro phosphorylation. I used circular dichroism spectroscopy to evaluate the secondary structures of mutant and wild- type SLX4 MBR. I conducted thermal denaturation experiments in the presence and absence of MUS81 to monitor thermal stability as a readout for protein-protein interaction.
Results: Phosphorylated wild-type and T1544A/T1561A SLX4 MBR proteins show alpha- helical character whereas T1571A shows a random coil. The structural transition from random coil to alpha-helix correlates with increased thermal stability in the presence of MUS81, indicative of a stable protein complex between SLX4 MBR and MUS81. Unexpectedly, thermal denaturation of T1544A/T1561A revealed unfolding at cold temperatures, absent in wild-type SLX4 MBR.
Conclusion: Phosphorylation of SLX4 T1571 is necessary and sufficient to stabilize the folded state of the SAP domain.

The nucleotide state of Rab7a impacts a3-containing V-ATPase localization

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Background: Vacuolar-type ATPases (V-ATPases) are ATP-dependent proton pumps that generate pH and electrochemical gradients across lipid membranes. The V-ATPase a-subunit has been shown to direct cellular localization of the complex, and it exists in four mammalian isoforms (a1, a2, a3, a4). The a3 isoform localizes to late endosomes that travel and fuse with lysosomes. Intracellular trafficking is regulated by Rab GTPases, molecular switches that are 'ON' when GTP-bound and 'OFF' when GDP-bound. Rab7a exhibits similar localization and interaction with a3, which suggests Rab7a activity could regulate a3 V-ATPase localization.
Objective: To determine if a3-containing V-ATPase movement is affected by the nucleotide state of Rab7a. We hypothesize that the nucleotide state of Rab7a impacts a3 localization. Methods: HeLa cells were transfected with GFP-Rab7a or mutants locked into the GDP(T22N), GTP(Q67L) or nucleotide-free(N125I) state with a3-mCherry. Confocal microscopy and LAS-X software used to image cells (n=10). ImageJ Coloc2 was used to quantify colocalization and generate a Pearson's Correlation Coefficient (PCC) for each transfection pairing. Data was analysed using one-way ANOVA and Bonferroni correction post-hoc pairwise comparisons.
Results: Strong colocalization of a3 with WT Rab7a (PCC=0.61) and Q67L (PCC=0.53) was found, which diminished for T22N (PCC=0.33) and N125I (PCC=0.49). There was a significant difference in colocalization between a3 and Rab7a compared to nucleotide mutants, as Rab7a T22N ($p=6.12 \times 10^{-5}$) or N125I (p=0.0105) were significantly less colocalized with a3 ($p < 0.0125$).
Conclusions: Our results demonstrate that Rab7a and Q67L had similar colocalization with a3, but T22N and N125I showed significantly less colocalization with V-ATPase a3.

Tracking immune cells in vivo: Use of a photoconvertible mouse to identify tissue-origin for cell migration in spinal cord injury

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Introduction: Spinal cord injury (SCI) is a life-altering condition caused by trauma to the spinal cord, commonly from motor vehicle accidents, resulting in paralysis below the injury level. The cellular immune response to this damage is integral to the healing process and is necessary for regeneration to occur. However, this same immune response can also contribute to secondary "bystander" injury wherein healthy tissue is damaged. Immune cells' migration to the injury site follows an orchestrated response, with specific timing of cell activation and recruitment. It remains unknown whether the tissue-specific origin of these cells plays a role in their injury response.
Methods: In this study, we use transgenic Kikume green-red (KikGR33) mice to follow the migration of photoconverted cells from key tissues to the injury site at different time intervals post-injury. KikGR mice express a knock-in mutation at the CAG promoter site that causes all tissues to express green fluorescent protein (GFP) until exposed to violet light, which induces a conformational change in the Kikume protein and leads to the targeted cells expressing red fluorescent protein (RFP). A compressive SCI is induced using the Infinite Horizons Impactor to closely resemble traumatic SCI in humans. At key time points after injury, a 405 nm wavelength laser is used to photoconvert the skin, spleen, liver, femur, cecum, or small intestine. Cells from these sites are then tracked to the spinal cord 2-24 hours after using flow cytometry and immunohistochemistry.
Results: These techniques will help us determine the tissue-specific origin of the immune cells infiltrating the spinal cord. This will also provide an avenue to understand how the tissue location of infiltrating immune cells influences their roles in secondary injury.
Conclusion: The tissue which immune cells migrate from to the site of spinal cord injury influences their function. This migration can be observed using a KiKGR mouse strain to characterize the tissue-dependent infiltration patterns.

Examining the effects of Sirtinol on bud development and detachment in Hydra viridissima: A research study

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Introduction: Hydra viridissima, a freshwater organism, reproduces asexually through the formation of buds on the body column. Bud development and detachment are crucial processes in Hydra's life cycle, and they are influenced by various factors, including cellular processes and gene expression. Sirtinol, known to inhibit sirtuin deacetylases (Class III HDACs), has been shown to disrupt regeneration and cell proliferation in a concentration-dependent manner. In this study, we aimed to investigate the impact of Sirtinol on Hydra bud development and detachment.
Methods: We isolated budding Hydra, randomly assigning them to control (0.1% DMSO) or treatment (5μM Sirtinol) groups. Morphology and bud development scores were monitored every 24 hours during a 96-hour exposure.
Results: Sirtinol had no discernible effect on the morphology and tissue homeostasis of the parent Hydra. However, it significantly delayed bud detachment by 24 hours. The median morphology score for buds in the Sirtinol group was markedly lower than that in the control group (N=12, **$P<0.01$), as were the bud development scores (N=12, **$P<0.01$). Moreover, the proportion of buds detached was lower in the Sirtinol group compared to the control group.
Conclusion: Sirtinol's inhibitory effect on sirtuin activity appears to disrupt the normal process of Hydra bud detachment, potentially by impacting cellular processes and gene expression involved in bud development and separation from the parent organism. This study provides insights into the regulatory mechanisms of bud development in Hydra and highlights the importance of sirtuins in this context.

Prevalence and neuroimaging predictors of social isolation and loneliness in older adults during the COVID-19 pandemic

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Introduction: Social isolation and loneliness during the COVID-19 pandemic have been reported in older adults, which are risk factors for medical and psychiatric comorbidity. Structural variations within brain regions that support emotion regulation are associated with loneliness and social isolation. This study aimed to 1) evaluate the extent of social isolation and loneliness in community-dwelling older adults during COVID-19 and their impact on mental health and 2) identify structural neuroimaging predictors of loneliness and social isolation in this cohort.

Methods: 180 older adults (mean age 76 years, SD=5.7) with mild cognitive impairment (MCI, N=39), remitted major depressive disorder (rMDD, N=28), rMDD+MCI (N=37) or who were cognitively unimpaired (N=76) were enrolled from studies that began prior to onset of the COVID-19 pandemic. Measures included the UCLA Loneliness Scale and Social Network Index. MRI scans acquired prior to March 2020 were available for a subset of participants (N=107). Regression modelling will be used to examine associations between regions of interest (medial prefrontal cortex, hippocampus, amygdala) and both social isolation and loneliness.

Results: 55% of participants reported moderate to moderately high levels of loneliness. Loneliness was associated with stress, post-traumatic stress, and depression ($r=0.49$, $p < 0.008$; $r=0.42$, $p < 0.008$; $r=0.56$, $p < 0.008$, respectively). Social network diversity was correlated with depression only ($r=-0.24$, $p < 0.008$). Neuroimaging data analyses are in progress.

Conclusion: Subjective feelings of loneliness during the COVID-19 pandemic were associated with poorer mental health outcomes in older adults. Smaller medial prefrontal cortex, hippocampus, and amygdala are predicted to be associated with social isolation and loneliness during COVID-19.

Gender-based differences of manifestations of celiac disease in CeliacCONNECT: The first Canadian pediatric celiac disease registry

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Introduction: CeliacCONNECT is a multi-centered prospective registry of Canadian children with celiac disease (CeD). The CeliacCONNECT registry collects presenting symptomatology that was identified by the diagnosing pediatric gastroenterologist. Previous research on adult populations determined that men and women report different symptoms at the time of diagnosis. Our aim is to assess the symptomatology of extra-intestinal manifestations and gastrointestinal symptoms of CeD at presentation and determine if any gender-based differences exist.

Methods: This study analyzed the presenting symptomatology of the enrolled patients from McMaster Children's Hospital and The Hospital for Sick Children from September 2020 to January 2022. Each symptom was analyzed for the frequency of presentation, and a chi-squared test was conducted to determine if any significant differences existed between genders. Descriptive statistics were used for baseline variables.

Results: Overall, the analysis included 407 patients (females n=242; males n=165) enrolled in CeliacCONNECT. The average age of diagnosis of male and female patients was 6.56 and 7.67 years, respectively. Abdominal pain was the most common gastrointestinal symptom reported at the time of diagnosis while fatigue was the most prevalent extra-intestinal manifestation. Our study found that there were no significant differences between females and males.

Conclusion: Children with CeD present with gastrointestinal symptoms most commonly however, they also experience a range of extra-intestinal manifestations. These include fatigue and growth concerns. While we did not identify gender-based differences in symptoms beyond dermatitis herpetiformis, children aged 6-11 were more likely to present with these symptoms.

Efficacy of ReadON in improving reading and writing skills in English and French- speaking students

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Introduction: This research pivots around the ReadON trial in a bilingual school, emphasizing personalized interventions for neurodiverse learners through an AI-backed neuroplasticity approach.
Methods: The study investigates the effects of ReadON on 38 neurodivergent children over six weeks, with participants engaging in 15 tailored therapy sessions aimed at enhancing their reading, writing, and comprehension skills.
Results: Significant positive outcomes were observed, with variations in growth rates across different age groups, highlighting age as a crucial factor in reading development. Older students demonstrated more remarkable progress in reading comprehension, especially the 18+ age group. Reading fluency peaked in early adulthood, while the reading rate showed wide variations across age groups. Word comprehension and identification displayed growth at specific ages, with some declines noted.
Conclusion: The consistency in results across both English and French language skills, despite using English materials, suggests potential for cross-linguistic interventions. The findings emphasize the need for age-specific interventions and tailored support for neurodivergent children. This research underscores the vital role of personalized, age-appropriate interventions in enhancing the reading abilities of neurodiverse learners. It provides valuable insights for educators and therapists, highlighting the effectiveness of digital cognitive therapies and their cross-linguistic applications.

Food literacy in New Brunswick youth: A research study

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Introduction: New Brunswick has one of the highest obesity rates in Canada. The future health of the province is influenced by the dietary habits and food literacy of younger New Brunswick generations. The objective was to conduct the first ever survey on the literacy knowledge of high school students in New Brunswick.
Methods: Online surveys of 15 questions adapted from the Swiss food literacy questionnaire with minor modifications were conducted with 225 students in grades 9-12. Food literacy among different gender, culture (mother-tongue language), and age were compared using t-test, one-way ANOVA, or chi-squared test.
Results: The average score of Francophone students (48 ± 5.4, n=93) was significantly higher than that of Anglophone students (43 ± 7.9, n=132, p=0.021). There was no significant difference between female students (42 ± 6.8, n=116) vs. male students (42 ± 7.5, n=91), p= 0.826. The average scores of grades 9 to 12 were – Grade 9 (42 ± 7.7, n=69), Grade 10 (42 ± 6.5, n=94), Grade 11 (40 ± 7.5, n=34), Grade 12 (44.6 ± 6.3, n=28), p= 0.094. Less than half of the students could answer the objective daily salt recommendation question.
Conclusion: The average score of this survey study was between 40-48 (65-75% of total). More education on food and nutrition is needed for high school students.

Enhancing VSV51 spread and replication in tumour cells through Topoisomerase I inhibitors

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Introduction: Research in the Diallo group has led to the development of a novel combination therapeutic approach involving oncolytic viruses (OV) and anti-body drug conjugates (ADC) to identify virus driven anti-tumour immune responses. The objectives of this study build on our published proof-of-concept data demonstrating improved efficacy from combining clinically approved ADC's and vesicular stomatitis virus (VSV51) in HER2+ cancer, in vitro and in vivo. The efficacy observed was attributable to mechanistic synergy between the two treatments, and impaired viral signaling which enhanced virus replication. Increased viral transgene expression was also observed. Groundbreaking findings have recently been reported in the clinic using a new HER2-ADC, linked to a topoisomerase type I inhibitor, and was shown to outperform previous drugs in the clinic notably due to its efficacy in HER2-low cancers. In fact, this class of drugs was shown to synergize with other OV's, including vaccinia virus.

Methods: The objectives of this proposed study are to demonstrate synergy between an untargeted topoisomerase I inhibitor and various classes of OVs in terms of cytotoxicity and OV replication in human and murine cancer cell lines, as well as HER2+ models in vitro, using patient derived ex-vivo tumour courses, and in vivo.

Conclusion: Through this combination approach, we hope to tap into another translational opportunity that can be afforded to patients living with HER2+ cancer, which is statistically highly aggressive with poor prognoses.

Mental health unplugged: Exploring the Muslim youth perspective on the digital revolution of mental healthcare
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Introduction: Access to mental health care in the Muslim community has long suffered from stigma (1,2). However, technological advancements have transformed the healthcare landscape, making mental health services more accessible and discreet. Telepsychiatry platforms now offer solutions for those in need, but it's vital to understand their reception within the Muslim community. This study aims to explore the perspectives among Muslims regarding online mental healthcare and discern if Muslim youth are targeted by these platforms. We aim to gain insights into Muslim attitudes, preferences, and the influence of culture and religious beliefs on their experiences with telepsychiatry and similar services.

Methods: We employed a snowball recruitment strategy, distributing a 13-question anonymous online survey to self-identifying Muslim students associated with McMaster University's Muslim Student Association. A cover letter detailed informed consent, data usage, reporting, and confidentiality standards, and we conducted descriptive statistical analysis.

Results: Our results will delve into the perception and acceptance of online mental health platforms among Muslim youth. We will provide insights into the current landscape of online resources and the marketing strategies aimed at the Muslim population.

Conclusion: Findings from this study will bestow valuable information to the field of mental healthcare. We will discuss strategies for healthcare providers and technology developers to improve their approach to serving the Muslim population. We aim to increase cultural competency and tailor online mental health services to meet the specific needs and expectations of Muslims, ultimately, promoting more inclusive and effective mental health care solutions for the community.

Parenting behaviours matter: A narrative review on anxiety disorder development in pediatric populations
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Introduction: Anxiety disorders are among the leading mental disorders diagnosed in pediatric populations. The literature currently has many conflicting findings surrounding the influence of parental rearing behaviours in its etiology. In particular, parental control, rejection, and specific attachment styles have been associated with an increased incidence of anxiety in their children. The purpose of this review was to synthesize extant literature for the current understanding of these factors on child anxiety.

Methods: A narrative review was conducted using the Scholar's Portall Journals and PsycINFO databases. Articles were screened for relevance to pediatric anxiety and parental rearing (i.e., control, rejection, attachment). Articles were excluded if they studied anxiety in the context of comorbidities, only examined one specific type of anxiety disorder, used non-pediatric samples, or measured anxiety after therapeutic interventions.

Results: 15 articles were included in this review. 13 articles correlated parental control and rejection with child anxiety, with 6 articles examining the influence of attachment. In general, high control and high rejection parenting was associated with higher reported anxiety symptomology, with a moderate and weak effect size respectively. Anxious attachment in particular was found to partially mediate associations of control and rejection to anxiety.

Conclusion: The current literature suggests a model for child anxiety development with parental control as the strongest contributor, and partial mediation of control and rejection through anxious attachment. These findings may help form the basis for future empirical research aiming to capture the influence of parenting on child anxiety.

Application of an ethical framework to machine learning-based biopsychosocial pediatric concussion subtyping

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Introduction: Globally, 20-30% of pediatric concussions result in persistent problems. Improving prognostication and symptom subtyping can facilitate early access to care and improve outcomes; however, noted health inequities among youth exposed to concussion raise fairness concerns for concussion subtyping. An unsupervised machine learning (ML) model designed to characterize concussion heterogeneity with multimodal data through cluster analysis, was assessed using an ethical framework. This study applies an institutional ethical framework (JustEFAB) to support the fair development of a concussion subtyping model.

Methods: Following the JustEFAB ethical framework, we first conducted a literature review on pediatric concussion outcomes to identify current knowledge on health inequities for concussion outcomes with MEDLINE [PubMED]. ABCD (Adolescent Brain Cognitive Development) publications were also included because the ML model is currently driven by an ABCD study cohort of 434 children. We developed an analytic plan to support the model's development and identified relevant ethical issues for consideration.

Results: 37 papers were used to identify 9 factors potentially influencing algorithmic bias: race and/or ethnicity, environment, socioeconomic status, gender and sex, neurodevelopment and psychology, parental influence, age, genetics and lifestyle. Relevant algorithmic fairness methods were identified to analyze these biases. Based on these results, we describe the ethical issues relevant to the potential clinical translation of the model.

Conclusion: We identified subgroups at the potential risk of algorithmic bias, while further supporting the ML model's clinical application. In the future, this should inform a collaborative and multidisciplinary approach that forms strategies to mitigate algorithmic bias within concussion predictions.

DLMO across lifespan

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Introduction: Dim light melatonin onset, DLMO, is the most accurate assessment of an individual's circadian rhythm. It determines if an individual's melatonin secretion falls within the standard 24-hour light/dark (LD) or a free-running state. This study aimed to determine if individuals in age range with features of depression, anxiety, and stress are more likely to attain a shifted DLMO result.

Methods: A post-hoc analysis of DLMO tests performed between 2017 and 2020 included 199 results that were split into three categories, pre-pubescent, pubescent, and post-pubescent, based on the expected timing that salivary melatonin levels would surpass three pg/mL, following the fixed threshold model. A chi-square test was done to determine if the observed and expected values were statistically significant.

Results: DLMO results were recorded as normal, abnormal advanced, abnormal delayed, and non-discernible. A majority (72%) of those in the pre-pubescent age were phase-delayed. A normal result was the most prevalent (71%) in the pubescent age range. A delayed DLMO result was the most prevalent (39%) in the post-pubescent range.

Conclusion: As age increased, the average time for an individual to surpass the three pg/mL threshold increased. In all age ranges, the observed results were statistically significant from the expected (p<t; 0.05). A non-discernable result was the most prevalent in the oldest age range. A normal result was the most prevalent in the pubescent group. It was expected that a delayed DLMO would be the most prevalent, suggesting that those with features of depression and anxiety are not likely to have a shifted DLMO result.

Rats anticipate damaged rungs on the elevated ladder: Applications for rodent models of Parkinson's disease

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Introduction: The study emphasizes the importance of flexible motor behaviors for object avoidance, particularly in the context of Parkinson's disease, which often leads to slow and rigid movements. The rats were tested on their ability to adapt to gaps in a ladder apparatus, and the results showed that encountering a breakaway rung following a step-up led to decreased velocity and stepping proportions. These findings have implications for understanding motor behavior differences and potential treatments for Parkinson's disease.

Methods: In this experimental setup, the ladder's incline was adjusted daily as needed. Two feeding cages were used to place the rats before and after each trial, with one placed on the counter next to the ladder and the other at the ladder's end. Trials were recorded using a GoPro HERO3+ camera, positioned on a tripod to capture the ladder, and lighting was provided by two 12V lamps. Rats were motivated to walk the ladder with Cheerios placed in the feeding cages.

Results: To analyze velocity data, the ladder was divided into four zones with distinct rung configurations. The study examined changes in 14th rung stepping proportions between baseline and breakaway conditions, considering the impact of incline. While a significant phase group interaction was found, there was no significant PhasegroupIncline effect. In the second experiment, a PhaseZone interaction was observed, with significant velocity changes in the third zone but no overall phase group incline zone interaction.

Conclusion: The study anticipated velocity slowdown near environmental breaks, especially in the second ladder zone, but found decreases primarily in the third zone, varying by incline and step direction.

The role of mGluR5 and PrPc in males vs. females in Alzheimer's Disease

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Introduction: Alzheimer's disease (AD) is a debilitating neurocognitive disorder characterized by memory loss and cognitive decline, resulting from extensive neuronal loss. Unfortunately, existing treatments have limited efficacy in attenuating disease progression. Original pathological hallmarks of AD include fibrillar plaques composed of Amyloid beta oligomers (Aβ) and neurofibrillary tangles, with Aβ42 as a primary source of neurotoxicity. Studies have shown that aberrant metabotropic glutamate receptor 5 (mGluR5) signalling in AD negatively influences learning and memory. Aβ complexes with Glutamate binding to mGluR5 triggers signalling cascades that modulate synaptic activity that negatively influences learning and memory. Cellular prion protein (PrPc) interacts with mGluR5 which acts as a scaffolding protein which leads to atypical signalling cascades. Our lab has demonstrated that modulating mGluR5 with a negative allosteric modulator only improves behavioral and pathological deficits in male AD mice, but not in females, suggesting sex-specific differences in Aβ/PrP c /mGluR5 complex signalling.

Methods: This project investigates sex-specific differences of Aβ42 impact on mGluR5 signalling using primary neurons at embryonic days 13-14. Neurons will be exposed to Aβ42 or a vehicle-control on day 6 in vitro and examined for interactions involving mGluR5 and PrPc. Neurons will be fixed and immunostained for PrPc and mGluR5, and co-localizing clusters will be counted. Sex determination of embryos is performed through PCR to target the SRY gene.

Conclusion: This comprehensive approach will highlight sex-specific variations in Aβ42 effects on mGluR5 signalling. The study's findings may deepen our understanding of mechanistic differences in AD progression between males and females, potentially leading to sex-specific AD therapeutics.

Is topical vancomycin effective in the prevention of surgical site infections in patients undergoing spinal surgery?

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Introduction: Surgical site infections (SSIs) are a potential complication that can occur after spinal surgery and immensely impact patients' well-being. Topical vancomycin has become an attractive low-cost intervention to prevent SSIs in spinal surgery. However, in current literature, the efficacy of topical vancomycin in preventing SSIs is a well-debated topic with

conflicting views. The primary objective of this critical review was to analyze relevant studies to evaluate whether vancomycin powder is an effective intervention in preventing SSIs following spinal surgery.

Methods: A widespread electronic literature search was performed using three primary databases: Medline, Embase, and Web of Science. Relevant studies were screened using pre- defined inclusion and exclusion criteria focusing on outcomes of postoperative SSI incidence rates.

Results: After full-text evaluation, 12 studies were included in this review, with a total of 9,224 patients. Five studies demonstrated a statistically significant decrease in SSI rates with the application of vancomycin powder. Three studies showed a statistically insignificant reduction in SSI rates between vancomycin and control groups, but one presented a statistically significant decrease after propensity score matching of patients. The final four studies showed no statistically significant difference in SSI rates between both study arms. Therefore, seven studies supported the beneficial use of vancomycin in preventing SSIs following spinal surgery, while the other five studies had opposing views.

Conclusion: Overall, these findings signify the necessity of well-designed RCTs to confirm the effectiveness of topical vancomycin in preventing SSIs during spinal surgery. Clinicians may consider the application of vancomycin with caution and on a case-to-case basis.

Natural language processing of radiology reports: Predicting metastatic progression from text data
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Introduction: The project's goal is to extract tumor measurement data from radiology reports with equal, or improved accuracy of a radiologist. The purpose is to optimize cancer treatment, accomplishing this through methods in artificial intelligence.

Method: In this experiment, a collection of radiology reports were used. After loading reports into a data frame, and a BioBERT (bidirectional encoder representations from transformers pre- trained on biomedical corpora) model into a virtual environment, a question is set to be answered by the model where the context of the question is each radiology report's findings section of the specified organ. These inputs are tokenized and embedded into numerical values to map sentences to vectors of real numbers. Vectors are fed into the model, and an answer is outputted in natural language. Answers are stored in the data frame in their respective rows.

Result: The model successfully answered questions about measurements of tumors written in text in reports where present, and ignored or did not report in cases where tumors were not present, or measurements were unchanged. In cases with multiple tumors, the model reported first listed measurements.

Conclusion: This project is evidence that using one question and selecting the findings portion of a radiology report for one organ as context in a BioBERT question-answering model is effective, and efficient in collecting measurements from radiology reports. This algorithm can be applied to other areas of medicine, or other fields entirely with a few alterations. This project is a step forward in optimizing cancer diagnosis efficiency and improving medical AI.

The effects of different insulin administration routes on glycogen metabolism in slow-twitch and fast-twitch muscle tissue
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Introduction: Type I Diabetes Mellitus (T1DM) is an autoimmune disorder that destroys beta cells in the pancreas which prevents insulin - a hormone that controls blood glucose levels - from being produced. A common route of exogenous insulin administration is through a pump which delivers insulin subcutaneously. The problem is that it does not resemble normal physiology. Theoretically, the omentum region would be a better anatomical location to deliver insulin. To test this alternative route, a Master's student in our lab inserted an insulin pellet in the omentum region of 12 Sprague Dawley male white rats with T1DM. The aim of my project is to see whether the omental pouch delivery compared to subcutaneous administration will normalize basal glycogen storage and glycogen utilization in slow and fast twitch muscle in male rats with T1DM.

Methods: The methods that I will use in my project are glycogen assays and immunoblotting techniques. I will look at glycogen content within the gastrocnemius muscles and different signaling proteins involved with glycogen metabolism.

Conclusion: Previous research has shown abnormal glycogen content in the muscles of T1DM rats treated with insulin, which likely has to do with the nature of subcutaneous insulin administration. In my project, we expect to see differences in glycogen content between both the SQ and OP groups.

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

Authors' Contributions
TAS, and RBE served 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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