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Connecting Young Minds (CYM) 2024 Undergraduate Research Conference: 5-Minute Scientific Research Presentations

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Abstract:
Connecting Young Minds (CYM) is a bilingual research conference at the University of Ottawa, created and run by students to enrich the experiences of undergraduates in Science, Technology, Engineering, and Mathematics (STEM). With a mission to inspire research interest and foster innovation, CYM offers students a unique platform to present their research to an audience and expert judges. Every year, the conference hosts a research competition where students submit abstracts or proposals. Selected candidates present their work in a five-minute session, followed by a Question & Answer period, with three grand winners chosen on the conference day. Additionally, students engage with industry professionals, keynote speakers, and past uOttawa valedictorians through presentations and networking sessions. Originally started within the Faculty of Science, CYM has expanded to reach all STEM faculties. With over 300,000 students engaged on social media, 1,000 new followers, and over 300 attendees, CYM is now uOttawa's largest STEM conference. As the university's only bilingual undergraduate research conference, CYM connects anglophone and francophone students with bilingual, world-renowned researchers, providing an exceptional platform for undergraduates to explore STEM fields and contribute to innovative research in a collaborative environment. Abstracts in this booklet were submitted by participants on a volunteer basis.

Keywords: Connecting Young Minds; undergraduate research conference; bilingual conference; scientific research; abstract competition; research presentations; science; technology; engineering; mathematics

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Conference Abstracts

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Connecting Young Minds 5-Minute Scientific Research Presentation Abstracts

Investigating chemoselectivity for hydrogenation in continuous flow mode: A framework for medicinal chemists

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Hydrogenation is among the most important transformations used in the synthesis of active pharmaceutical ingredients. The ability to accurately target the hydrogenation of individual functional groups in these molecules is of great value in the pharmaceutical manufacturing industry, as many complex molecules contain multiple functionalities which are susceptible to being undesirably reduced. This study aims to develop a general guide of reaction conditions and transition metal catalysts to use to chemoselectively hydrogenate specific functional groups. To accomplish this, in collaboration with an industrial partner, we chose model substrates with functionalities that are most relevant to medicinal chemistry. Among these reactions are nitro reduction, debenzylation, alkene and N-heterocycle reduction, and dehalogenation. Solutions containing each selected molecule were reacted in continuous flow mode with hydrogen gas, being pumped through a packed bed reactor containing a heterogenous metal catalyst, such as Pd/C, Rh/C or Pt/C.

Hydrogenation reactions are inherently hazardous and inefficient, especially in batch reactors. However, doing these reactions in flow can help to mitigate these issues by means of better mass and heat transfer as well as smaller reactor volume. These reactions were done in progressively harsher reaction conditions, with pressure, residence time and temperature all being ramped up continuously. The yield of the hydrogenation for each substrate with each catalyst was plotted as a function of reaction condition harshness. With 10 model substrates each being hydrogenated using 10 unique transition metal catalysts, 100 such plots were created. By analyzing each plot, the selectivity of each catalyst for each functional group was quantified and tabulated. Using these results, chemists can easily select catalysts which have a high selectivity for the hydrogenation of target functionalities, and a low affinity for functionalities which they wish to protect.

Plasma ß-hydroxybutyrate in healthy young women following acute intermittent and continuous hypoxemia in the postprandial state: Preliminary findings

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Ketone bodies are mainly composed of ß-hydroxybutyrate (ßOHB) and are crucial to providing alternative methods of fuel for the human body. Reductions in oxygen availability (hypoxemia) can increase circulating ßOHB levels, mainly through elevations in non-esterified fatty acids (NEFA). However, previous studies in humans are limited to healthy young men, it remains unclear whether hypoxemia also increases ßOHB in women. Additionally, it remains unclear how different hypoxemic doses influence elevations in ßOHB. This study evaluated the effects of different hypoxemic doses (intermittent and continuous hypoxemia) on circulating ßOHB levels in healthy young women. Twelve healthy young women (mean age [SD], 21 years [3]) were randomly exposed to normoxia (fraction of inspired O_2 = 0.2093, ~98% oxyhemoglobin [S_pO_2]) and intermittent hypoxemia for 6 hours following ingestion of a meal (33% of estimated daily energy expenditure) as part of a larger research project. Intermittent hypoxemia was administered at rest using 100% nitrogen until S_pO_2 dropped to 85%. Fifteen hypoxemic cycles were administered hourly. For this study, a sub-group of participants (n = 6) were exposed to continuous hypoxemia (simulated altitude of ~5000m above sea level; fraction of inspired O2 = 0.1200; ~80% S_pO_2). Colorimetric assays were used to measure plasma NEFA and ßOHB levels hourly. Data were analyzed using linear mixed-effects models (alpha of 0.050). Results showed plasma NEFA and ßOHB levels increased over time across all conditions (main effect of time: both $p < 0.001$). Plasma NEFA levels were similar between conditions (main effect of condition: $p = 0.229$). However, plasma ßOHB levels increased to a greater extent after 6 hours of continuous hypoxemia (40% higher than normoxia and 44% higher than intermittent hypoxemia; condition x time interaction: $p = 0.019$). Our results indicate that hypoxemia-induced elevations in plasma ßOHB levels are dose-dependent during the postprandial state in healthy young women.

Alzheimer's disease progression driven by central nervous system inflammation: A research proposal

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Alzheimer’s disease (AD), the most prevalent form of dementia, involves neuronal loss and cognitive decline from accumulated amyloid-beta plaques and tau tangles in the brain. Increasing evidence highlights chronic inflammation in the central nervous system (CNS) significantly drives AD progression. Microglia, the CNS’s resident cells, generally protect neurons but can exacerbate inflammation and neuronal damage when stimulated by plaques. This study aims to advance understanding of CNS inflammation’s role, focusing on microglia signaling mechanisms and the marker P2RY12 in neuronal deterioration in AD. This knowledge is pivotal to develop treatments for disease deceleration or halt. This study hypothesizes that amyloid-beta plaques and tau tangles accumulation triggers microglia overactivation via specific signaling pathways, leading to enhanced inflammatory responses and neuronal damage, which contribute to cognitive decline and advance AD progression. To investigate, the study will analyze key signaling pathways and molecular markers associated with microglial activity, focusing on P2RY12, a microglia-exclusive receptor critical in homeostasis, using Western blotting and RNA sequencing. Since P2RY12 expression alters with microglial activation states, tracking these changes will help elucidate the mechanisms by which microglial overactivation advances neurodegeneration in AD. The study expects to find that dysregulated microglial activity, marked by changes in P2RY12

expression, significantly contributes to AD progression by intensified inflammation and neuronal damage. These findings will support the hypothesis and reinforce existing evidence pertaining to CNS inflammation involvement in Alzheimer's disease. Overall, the study showcases the identification of P2RY12 expression changes in response to microglial overactivation which accelerates AD progression, enhancing understanding of these mechanisms and providing insights for future treatment options. Future research will focus on therapeutic interventions targeting microglial activity, starting with efficacy testing in animal models and advancing to human trials. Exploring additional molecular signaling pathways in microglial activation will further treatment options and connect theoretical research with clinical application.

Are synthetic patient generators hallucinating?

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In Synthetic Data Generation (SDG) a machine model is trained on input data and new "artificial" data is sampled from the learned distribution. This process can preserve privacy while maintaining utility for downstream analytic tasks. However, implausible, inconstant or non-existent records (i.e., hallucinations) may be generated, eroding the utility of and trust in this emerging technology. This study investigates the occurrence of hallucinations in SDG, their distribution across techniques and data dimensionality. Data from the Better Outcomes Registry & Network (963,083 records, 120 variables) was used in this study to build 100 populations by randomly varying the number and selection of variables. From these populations, 10,000 records were sampled into a training dataset for SDG using TVAE, CTGAN and Bayesian Networks. Hallucinations were then defined as those records that have a Hamming distance to records of the population above 0 (i.e., non-existent in the population). Numerical values were discretized before the distance measurement. Across all synthetic datasets, there was an average of 5501 hallucinations (SD 3073, 55.0%). The number of hallucinations varied across different SDG techniques and with changing dimensionality. TVAE, for example, had fewer hallucinations (mean 5003, SD 3249, 50.0%) compared to Bayesian Networks (mean 5355, SD 3264, 53.6%) and CTGAN (mean 6147, SD 2576, 61.5%). Increasing dimensionality led to higher numbers of hallucinations across all SDG techniques, ranging from 2495 (SD 907, 24.9%) with 20 variables up to 9996 (SD 7, 100%) with 119 variables. These results suggest that hallucinated records can form a major portion of synthetic data, in high-dimensional data, reaching even 100%. Such a generalizing and diversifying aspect of SDG may be beneficial for model performance but may also undermine trust in the technology. Subsequent research is planned to focus on the effect of hallucinations on such downstream tasks.

Significance of chlorophyll fluorescence parameters in understanding plant growth

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Chlorophyll fluorescence is the amount of light re-emitted by chlorophyll molecules during return from excited to non-excited states. This is useful in measuring the rate of photosynthesis of plants and therefore provides insights into the amount of organic energy that has been produced. My study explores the applicability of chlorophyll fluorescence parameters in assessing the seasonality of photosynthetic growth in coral reefs. Coral reefs, vital marine ecosystems, are significantly influenced by environmental factors such as temperature, light availability, and ocean acidification. Understanding the seasonal variations in their photosynthetic activity is crucial in the assessment of the overall health and sustainability of these ecosystems. My research utilized data from the Coral Monitoring Station (CMS) in Eilat, Israel, focusing on two coral species: *Stylophora pistillata* and *Pocillopora damicornis*. Chlorophyll fluorescence parameters, including effective photochemical quantum yield ($Y_{(II)}$) and relative electron transport rate (ETR), were analyzed over a year to detect patterns corresponding to seasonal changes. The results revealed clear seasonal trends in both $Y_{(II)}$ and ETR, with higher photosynthetic efficiency observed during warmer months. These findings support the hypothesis that chlorophyll fluorescence parameters can effectively indicate seasonal changes in photosynthetic activity within coral reefs. In conclusion, my study underscores the importance of using real-time fluorescence data to monitor coral health, particularly in light of increasing environmental stressors due to climate change, and contributes to a broader understanding of coral reef ecology. The use of chlorophyll fluorescence as a non-invasive, real-time monitoring tool has

potential applications in conservation efforts, thereby illustrating the resilience of coral reefs in changing marine environments.

Changes in autophagy-related proteins and inflammatory markers in peripheral blood mononuclear cells from young adults following a high-fat meal under intermittent hypoxemia stress: Preliminary findings

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Obstructive sleep apnea (OSA) is marked by sleep fragmentation and intermittent hypoxemia, which impairs cellular immune function. Further, high-fat diets can worsen cellular immune function by increasing inflammation, and may also modulate cellular survival mechanisms (e.g., autophagy) in immune cells such as peripheral blood mononuclear cells (PBMCs). However, how dietary factors influence immune function in relation to OSA remains unclear. Therefore, this study investigated whether postprandial inflammation coincides with changes in autophagy within PBMCs and assessed whether these responses are altered by intermittent hypoxemia. Using a randomized crossover design, 4 young adults (2 men, 2 women; mean age [SD], 22 years [5]) were exposed to normoxia (ambient air: 20.93% oxygen, ~98% oxyhemoglobin [S_pO_2]) and intermittent hypoxemia for 6 hours following the ingestion of a high-fat meal (33% of estimated daily energy expenditure, 59% calories from fat). Intermittent hypoxemia was administered at rest using 100% medical-grade nitrogen until S_pO_2 dropped to 85%. Fifteen hypoxemic cycles were administered hourly, representing moderate OSA. Autophagy-related proteins (microtubule-associated protein 1 light chain 3 [LC3]-II) and inflammatory markers (interleukin-6 [IL-6]) were assessed in PBMCs at baseline, and after 3 and 6 hours of exposure via Western blot. Data were normalized to ß-actin (expressed as a relative quantity [RQ] from baseline) and were analyzed using two-way ANOVA with Tukey's post hoc test and an alpha set at 0.050. IL-6 increased during normoxia after 3 hours (1.5RQ [0.4], $P_{Tukey} = 0.046$), returning to baseline after 6 hours. There were no changes in IL-6 during intermittent hypoxemia. This was paralleled by a trend towards higher levels of LC3-II during normoxia compared to intermittent hypoxemia ($p = 0.063$, $\eta_p^2 = 0.735$). These results indicate that inflammatory and autophagic responses to a high-fat meal during intermittent hypoxemia may be altered compared to normoxia. Larger studies are needed to confirm this hypothesis.

The correlation between the *Human Development Index (HDI)* and the mortality rate due to air pollution in the *WHO SEAR* region and the *WHO EUR* region: A correlation study

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Air pollution is a fatal issue pertaining to public health concerns. Equally, the *Human Development Index* (HDI) and the statistics published by the *World Health Organization* (WHO) permit the study of the progression of a country by numerous factors, such as the quality of life and the national health of the country. The question poses as such: What is the correlation between the HDI and the mortality rate due to air pollution? In fact, polluting agents all around the world are destructive to the planet and people are no exception. The methodology is comprised of the comparison and contrast of the HDI and the mortality due to sir pollution in the WHO Souh-East Asia Region (SEAR) and the WHO European Region (EUR). The objective is to find the associations between the statistics of 30 countries in order to draw conclusions on the correlation between these two health and mortality indicators. The results indicate a strong, linear, negative correlation, which signifies essentially that a country with a higher HDI has lower mortality rates due to pollution, confirmed with a *Pearson correlation test*. The data and analysis support the idea that a nationally developed country contributes greatly to the reduction of the consequences of air pollution. In order to improve the quality of life and reduce air pollution complications in all countries, it is essential to properly work on health infrastructures and environmental politics, especially in developing countries where the impacts of these deficits are deathly eminent.

Correcting splicing aberrations by targeting non-canonical splicing

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Neuronal ceroid lipofuscinosis type 2 (CLN2) disease is an inherited and fatal neurodegenerative disorder, most present among young children. Currently, enzyme replacement therapy (ERT) is the only known treatment, unable to halt disease progression, and leaving patients with a significantly short lifespan. The urgently progressing disease is caused by mutations in the *tripeptidyl peptidase 1* (*TPP1*) gene located on chromosome 11p15, resulting in dire enzyme deficiency and impaired lysosomal function. The deficiency leads to accumulation of cellular debris that contributes to neuroinflammation, cell damage, and neurodegeneration. Studies on RNA sequencing of *TPP1* have identified events of aberrant splicing, resulting in truncated and non-functional proteins. By targeting non-canonical splicing events in *TPP1* using oligonucleotides (ASOs), dysregulations may be corrected and establish proper splicing. Potential NCSEs within the TPP1 gene are identified using bioinformatics tools and RNA sequencing data. ASOs are designed to bind to the mutant RNA and block the sequences, inhibiting aberrant splicing. Fibroblasts from tissues of patients with CLN2 following ASO treatment are then analyzed through RNA sequencing and splicing patterns for experiment validity. Protein and enzyme activity levels are evaluated for both the control and treated group, disclosing functionality of targeted mutagenesis. The procedure is expected to display an increase in enzymatic activity along with accurately spliced transcripts in ASO treated cells. Statistical tests can help confirm and compare the data derived from addressing genetic mutations. This targeting approach shows promise in the development of new effective treatments and patient outcomes. Successful correction and re-establishment of enzyme levels reveal the potential of non-canonical splicing targeting in CLN2 disease and can be implemented in future studies towards a broader spectrum of neurodegenerative diseases. This study may unveil new possibilities in therapeutic approaches for clinical use-essential to early detection, and research innovation.

Investigating the addictive potential of simple and refined carbohydrates and their impact on predisposition to other addictions and impulsivity in rats: A research proposal

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With simple carbohydrates constituting a large portion of the average Western diet, it is imperative to investigate their potential risks. Previous studies have indicated that highly processed foods, rich in refined in refined carbohydrates may exhibit addictive properties similar to that of substances such as nicotine and alcohol. The addictive nature may be tied to the nucleus accumbens (NAc) and dorsal prefrontal cortex (PFC): the reward and motivation centers of the brain linked to addiction and impulsivity. This research aims to investigate the effects of diets high in simple and refined carbohydrates on the NAc and dorsal PFC in rats, focusing on addiction-like behaviors and impulsivity, to determine the effect of carbohydrates on brain development. In the proposed study, Long-Evans rats will be intermittently given access to rations of their prescribed diet for self-administration of 6 weeks; after which all rats will follow the control diet for one week. At the end of every week, the rats will be assessed for their extent of addiction through behavioural economics demand curves, for impulsivity using 5-choice serial reaction time tasks (5-CSRTT), and for neural activity in the NAc and PFC via in vivo microdialysis throughout the tests. This study aims to provide a deeper understanding of refined carbohydrates and their interactions with brain development specifically in regions associated with addiction and impulsivity. The findings could have significant implications for dietary recommendations and public health policies, and potentially highlight the caution required in consuming simple carbohydrates.

Impact of virtual reality on cognitive rehabilitation in post-stroke recovery

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According to the World Health Organization, fifteen million people worldwide suffer a stroke each year leaving 5 million survivors permanently disabled, often resulting in cognitive impairments that hinder daily functioning and quality of life. Traditional cognitive rehabilitation methods have limitations in engagement and adaptability. Virtual reality (VR) technology is emerging as a promising tool in the cognitive rehabilitation of stroke patients. Supporting cognitive rehabilitation with VR can improve cognitive outcomes more effectively than traditional methods. VR provides an immersive and interactive environment that significantly enhances cognitive recovery, particularly in memory, attention, and executive functions.

Compared to traditional methods like paper-and-pencil exercises, VR offers advantages such as immersion and socialization. This application features two groups of stroke patients, one receiving VR-based cognitive rehabilitation and the other undergoing traditional therapy. The VR interventions simulated real-world tasks that engaged cognitive processes, using tools like puzzle games, virtual prism, camera-based sensors, while the control group participates in standard rehabilitation exercises. Standardized neuropsychological tests (MoCA, WAIS-IV) will be administered at baseline, mid-point, and post-intervention to evaluate cognitive improvements, goes up to 12 weeks. The trial involving 30 stroke patients revealed that the VR group experienced significantly greater improvements compared to the control group, particularly in attention and memory retention, and reported higher levels of engagement and motivation, leading to better adherence to the rehabilitation protocol and improved mood and mental health. VR-based cognitive rehabilitation appears to offer superior outcomes over traditional methods, providing a more engaging and effective approach to cognitive recovery. This underscores the potential of VR as a transformative tool in neurorehabilitation, with future research needed to explore the long-term effect of VR on stroke patients to establish its role in long-term recovery and neuroplasticity.

A generative adversarial network for data augmentation of ictal waves from multi-electrode brain activity

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Previous research focusing on predicting the occurrence of epileptic seizures has trained deep neural networks with electroencephalogram (EEG) data to assess how accurately artificial intelligence can distinguish between healthy and pathological brain activity. However, research is limited by the scarce amount of available data. The challenge of finding animal disease models, and the infrequency of ictal waves in epileptic networks hinder data collection, highlighting the importance of investigating data augmentation with generative adversarial networks (GANs), which are deep-learning models that are trained with real data to generate large amounts of plausible synthetic images. We propose the use of GANs for data augmentation of multi-electrode-array (MEA) seizure wave recordings as a solution for data shortage and to improve discrimination performance. With an increasing number of synthetic data in the training datasets of convolutional neural networks (CNN), classification accuracies will significantly improve. The first part of our study focuses on assessing how classification accuracies change as the amount of synthetic data systematically increases in the CNN training dataset. In the second part, we compare results to normal trials that do not include augmented data. We use a computational neuroscience approach using deep learning convolutional networks and GANs. Classification accuracies were significantly improved as the number of synthetic images in the training datasets increased, reaching maximal performance with 500 images. Data augmentation using GANs for ictal waves recorded with MEAs significantly improved the training of deep learning models and enhanced the classification accuracy of epileptic brain activity. Studies should aim to incorporate GANs to expand datasets. Our findings show promising avenues for research on predicting epileptic seizures in medical applications.

The media coverage of mental health on social media and its implications in mental health disorders

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The use of social media has become an essential part of young people's daily lives. Platforms where more and more individuals share content related to mental health are gaining massive popularity. The number of people with mental health disorders who publicly share their experiences and symptoms is steadily increasing. One can observe a genuine emergence of individuals convinced that they have a mental disorder based on self-diagnosis. Mental health issues have become both attractive and glorified. A widely observed phenomenon that is described by doctors, involves young people developing tics, characteristics of Tourette Syndrome (TS), a chronic neurological disorder, after consuming online content from influencers with this condition. Similarly, there is an increase in self-diagnosed cases of Dissociative Identity Disorder (DID). This research aims to explore the relationship between the media representation of mental health content and its implications in mental health disorders. It seeks to determine whether there is, in fact, social contagion of psychological disorders and if exposure to content about a mental health condition has a statistically significant effect on the emergence and intensification of the symptoms that characterize it. The study focuses on DID and TS as the primary cases. A longitudinal experimental design will be implemented, exposing teenagers aged between 11 and 19 to mental health-related content. A diagnosis of the specific disorder will be conducted before and after the experiment, with a control group included. Additionally, an exploration of the physiological, biological, and neurological aspects of this phenomenon is necessary to examine the extent of the supposed self-conditioning.

Mindful strides: Exploring the impact of mindfulness interventions on self-reported quality of life in adolescents with idiopathic scoliosis

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Current research states that adolescent idiopathic Scoliosis (AIS), a curvature of 10 degrees or more of the spine, is the most common form of Scoliosis, with an incident rate much higher in females than males between the ages of 12 and 18. Furthermore, individuals with curvatures exceeding 20 degrees exhibit a reduction in quality of life (QOL) in areas such as body image and self-perception due to external deformities. While research has examined the consequences of AIS, there remains a notable gap in the literature concerning psychosocial interventions aimed at improving AIS QOL. It is unclear whether Mindfulness-based Stress Reduction (MBSR) can benefit AIS patients despite its growing popularity in addressing QOL in other health conditions. Thus, our study aims to address this gap by conducting a basic experimental between-subject design to explore the effectiveness of a 1-hour weekly MBSR course on AIS patient's QOL. Measuring the program's efficacy will be done by administering three questionnaires at baseline, with additional evaluations at the 8-week mark, post-intervention, and a 3-month follow-up. The assessments used are the Scoliosis Research Society 22r (SRS-22r), the Pediatric Quality of Life Inventory (PedsQL), and the Five-Facet Mindfulness Questionnaire (FFMQ-SF). Our study hypothesizes that a sample of 40 females aged 12 to 17 with AIS and curvatures between 20 and 35 degrees who complete a 12-week directed MBSR course will report an increase in their quality of life via self-reported questionnaires compared to those who did not participate. This study, to our knowledge, being the first of its kind to address treating QOL in AIS patients, will provide empirical evidence for the efficacy of MBSR in improving QOL for AIS patients, facilitating its incorporation within existing treatment regimens and fostering future research, thereby underscoring the wider-reaching importance of this study.

Characterizing histone metapeaks in cancer epigenetics

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Genomic epigenetic modifications are heritable alterations that do not change the genomic DNA sequence and play a crucial role in regulating gene expression. Among these, histone modifications, such as acetylation and methylation, influence genome accessibility, thereby controlling gene expression at critical regulatory regions like promoters and enhancers. Aberrant histone modifications have been linked to various cancers, suggesting that analyzing these modifications could yield insights into cancer development. This study aims to identify histone "metapeaks," regions of dense histone modifications that may be associated with cancer. We hypothesize that specific histone modification metapeaks will differ between healthy and cancerous tissues, potentially affecting nearby genes implicated in cancer. To test this hypothesis, we analyzed six histone marks (H3K27ac, H3K27me3, H3K36me, H3K4me1, H3K4me3, and H3K9me3) using ChIP-seq data from thousands of samples. In the first aim, we conducted t-tests on metapeak data from healthy and cancerous samples to obtain p-values, followed by Benjamini-Hochberg (BH) correction for multiple comparisons all by using Python software. This allowed us to identify statistically significant differences in histone modifications. In the second aim, we used GREAT software to link these significant metapeaks to nearby cancer-related genes, such as oncogenes and tumor suppressor genes. Preliminary results revealed multiple hits within two specific histone metapeaks that exhibit altered modification patterns in cancer through overlapping genes. These findings can enhance our understanding of how epigenetic modifications contribute to cancer progression. In the future, this research could inform targeted therapies potentially offering new approaches to cancer treatment, such as drug response profiling, machine learning outcome-prediction, and targeted cancer gene research.

The autophagic response to an equivalent exercise and passive-induced heat stress

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The process of autophagy is vital to cellular survival during exposure to acute physiological stressors (i.e., exercise and heat stress). However, it remains unclear whether activation of autophagy differs between a metabolic (exercise) and heat-induced (warm-water immersion) stress, and if aging mediates this response. We evaluated the hypothesis that autophagic activity

would be i) greater in response to an equivalent increase in core temperature induced by exercise as compared to passive-heating and ii) responses would be attenuated with aging. Ten young (mean [SD]: 22 [2] years) and 10 older males (70 [5] years) performed 30 min of semi-recumbent cycling (70% maximal oxygen uptake). On a separate day, participants were immersed in warm water for 30 min, with the water temperature adjusted to induce the same increase in core temperature (rectal) as the prior exercise bout. Proteins associated with autophagy (LC3-II and p62) were assessed in peripheral blood mononuclear cells via Western blot before and after each exposure and during a 6-hour seated recovery in a temperate environment (~22°C). No differences in core temperature occurred at end-exposure to exercise or passive heating in either group (both, $p \geq 0.999$). In response to exercise and passive-heating, young adults experienced similar elevations in LC3-II across both conditions (time main effect: $p=0.022$), with similar declines in p62 to both exercise and heating (time main effect: $p=0.005$). Conversely, older adults exhibited greater LC3-II protein accumulation to exercise relative to passive heating at all timepoints (3.3-fold average relative increase; all, $p \leq 0.022$), with autophagic impairments observed with passive heating alone (elevated p62; condition main effect: $p=0.044$). While brief exercise stimulates autophagy, exposure to an equivalent passive-induced heat load may underlie autophagic dysregulation in older adult males. Further investigation is required to determine whether these findings extend to females.

Artificial intelligence-driven solutions to promote operating room efficiency and productivity in thoracic surgery

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Escalating demands and costs of healthcare have made it increasingly difficult to regulate healthcare spending. The operating room (OR) is a prominent target for improvement, as inefficiencies in OR utilisation account for up to 30% of surgical care costs. Advances in artificial intelligence (AI) and machine learning (ML) provide new opportunities to enhance OR efficiency by analysing interactions among factors influencing OR workflow. This study focuses on thoracic surgery at The Ottawa Hospital, applying ML algorithms to identify key metrics contributing to successful completion of lung resection procedures. We hypothesise that our model will identify specific metrics contributing to successful case completion in a standard thoracic surgery OR day and establish benchmarks for these time intervals which can predict higher rates of OR success. Following a data-cleaning process, we will analyse time data recorded during surgeries, using the Boruta algorithm for feature selection, and develop a supervised ML model to predict OR success based on specific time intervals. Additionally, the study will utilise the AI and available surgical data to identify "positive deviants"—team members who consistently exceed efficiency benchmarks— and extract their strategies through structured interviews to share via seminars and focus groups. Preliminary analysis indicates that efficient preparation and starting a day on time majorly influence the success of the day. Prolonged anaesthesia preparation or exceeding the expected procedure duration reduced the likelihood of on-time completion. Patient metrics, like BMI and ASA classification, may also impact the surgical prep intervals or the operation length. Success rates notably dropped during the COVID-19 pandemic and have not since recovered. We anticipate that the time intervals have a greater influence on surgical success than patient metrics. Starting on time and maintaining pace throughout critical time intervals— particularly anaesthesia preparation and the procedure itself— could play a key role in improving SSR.

Exploring biological sex differences in cortical responses to non-invasive brain stimulation: A systematic literature review

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Non-invasive brain stimulation (NIBS) encompasses various brain stimulation techniques used to diagnose and treat neurological and psychiatric disorders. Transcranial magnetic stimulation (TMS), to illustrate, is used in the treatment of drug-resistant major depressive disorder (MDD) and has been proven more effective in females than males. Despite this finding, there is a lack of data analyzing sex differences in responses to the many existing stimulation techniques. To address this gap, we reviewed the literature examining sex differences in cortical NIBS responses. Two independent authors

performed an OVID-MEDLINE search (1946–May 2024) and screened articles based on predefined inclusion and exclusion criteria. Data from the yielded articles was extracted and analyzed. Results show that following TMS, sex differences were noted in motor evoked potentials (MEP), intracortical inhibition and facilitation (ICI and ICF), silent periods (SP), corticospinal excitability (CSE), hormones, transcallosal conduction time (TCT), compound muscle action potentials (CMAP), motor thresholds (MT), peripheral and central motor conduction times (PMCT and CMCT), neural response waves, and neurological indexes (NI). For repetitive TMS (rTMS), differences were noted in MEPs, ICI/ICF, hormones, MTs, and biomarkers. For paired-associative stimulation (PAS), differences were noted for MEPs, SPs, and hormones. For transcranial direct current stimulation (tDCS), differences were noted for MEPs and ICI/ICF. This review offers important insights into sex-specific differences in cortical responses. These insights can guide the development of NIBS parameters, sex-specific therapeutic and diagnostic protocols, and future research. The body of literature is, however, still lacking. Further research should aim to examine sex differences in responses to rTMS, PAS and tDCS.

Enhancing antibiotic stewardship in Nigeria's private healthcare sector: A feasibility study

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Nigeria, with other West African nations, face a disproportionate share of the burden of morbidity and mortality associated with antimicrobial resistance (AMR). The country's drug-resistant bacterial infections are estimated to cause 27 deaths per 100,000 yearly. This problem is made worse by the inappropriate use of antibiotics, especially in Nigeria's heterogeneous and fragmented private healthcare system. Given the lack of specialized strategies to regulate antibiotic use in this setting, this study seeks to identify specific barriers, challenges, and facilitators for the development of an effective antibiotic stewardship intervention tailored to private healthcare practitioners in Nigeria. There will be approximately twelve 60-minute, in-depth interviews held with prominent Nigerian policymakers as well as representatives of relevant professional associations. The goal of these semi-structured, audio-recorded, and transcribed discussions will explore these primary obstacles and promoting factors to the implementation of such interventions. Subsequently, 150 private healthcare practitioners in the states of Lagos and the Federal Capital Territory (FCT) of Nigeria will be invited to complete an online survey questionnaire. Practitioner characteristics, knowledge and attitudes on AMR, antibiotic prescribing practices, prior AMR-related education or training, and willingness to participate in stewardship activities will all be examined in the survey. The study highlights the potential for significant insights into the specific factors influencing the implementation of an antibiotic stewardship intervention within Nigeria’s private healthcare sector. This will help to establish a framework for a future pilot cluster randomized controlled trial which evaluates antibiotic prescribing practices among participating healthcare providers. This raises the opportunity for larger scale efforts to successfully tackle AMR in West Africa and other comparable regions, ultimately contributing to global efforts in addressing this critical issue.

Analysis of frozen embryo transfer cancellation and pregnancy rates: A data-driven retrospective study

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Advancements in assisted reproductive technologies (ART) have revolutionized fertility treatment, offering hope to individuals struggling with conceiving, recurrent miscarriage, and other reproductive challenges. Among these innovations, movement toward frozen embryo transfer (FET) has become a viable treatment approach, improving clinical outcomes. Endometrial preparation, whether through natural cycle, ovarian stimulation, or hormone replacement therapy, can significantly influence these outcomes, demonstrating the need for individualized approaches to reduce cycle cancellations and increase pregnancy rates. Compared to fresh embryo transfer in in-vitro fertilization (IVF) cycles, FETs generally exhibit lower cancellation rates, more favourable pregnancy rates, and possible reduced pregnancy morbidity. Clinical FET pregnancy rates using own oocytes are reported as 39.7%, according to the Canadian ART registry. This effectiveness is partly due to the cryopreservation of embryos, giving the body time to recover from initial IVF stimulation, returning to a more physiologic state before transfer. FET also allows for genetic testing of embryos, helping to control for the most

common cause of miscarriage - embryonic aneuploidy. Not all patients returning for FET proceed directly to the transfer procedure. Our objective was to quantify patients who initiate, complete, and achieve pregnancy through FET to assess cancellation and pregnancy rates. We hypothesize that approximately 15% of patients will have their FET cancelled before embryo transfer, and around 40% will conceive if they do proceed. These estimates correspond to typical benchmark standards and will be compared to our data, evaluating FET effectiveness. A retrospective chart review with convenience sampling from January 2022 to May 2024 was performed. We utilized a quantitative scientific approach by cross-matching data from two databases and employing statistical averaging to compare cancellation and pregnancy rates. Our data revealed an average FET cancellation rate of 6.8% and pregnancy rate of 45.7%. The observed FET cancellation and pregnancy rates exceed typical benchmarks, indicating potential improvements in FET effectiveness and providing accuracy for counseling patients on outcomes. Further research may explore subcategorization of patient populations analyzed, such as age, controlling for confounding variables, as well as determining reasons for cancellations with intention to continue improving outcomes.

The effectiveness of school-based swimming lessons compared to community-based lessons

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While safety concerns have led to worldwide innovative approaches to reduce risks for the community, such as seatbelts and airbags in cars, why are swimming lessons, which teach vital life-saving skills, a privilege in the community? The current parent-initiative swimming lessons are undermined by: economic pressures, lack of value within households, and lack of accessibility in the community. Consequently, the percentage of children comfortable with their swimming ability is decreasing and will continue to decrease substantially as the community grows. Thus, increasing the number of drowning and near-drowning incidents in the community. The proposed research examines what impact mandatory school-based swimming lessons have on children's swimming ability compared to that of community-based lessons. To examine this, the research involves providing a mandatory 12-week session of swimming lessons for all grade 2 students at l'École élementaire publique Francojeunesse. The thesis is the number of students who reach the Level 2 (Coral) criteria of the current Swim City program will significantly increase compared to that of the control school, York Street Public School. The research data will be gathered by surveying the students' comfort and confidence around water and their ability before the lessons begin and then comparing after completing the 12-week session. Researching this concept will show the value of school-based lessons compared to that of community-based lessons on children's swimming ability and confidence. Increasing mandatory accessible swimming lessons for children will decrease at-risk individuals, decrease drowning incidents, and increase the community's water safety knowledge. By proving the solution lies in school-based swimming lessons, this small-scale program can be implemented as a new swim curriculum across school boards to ensure all children receive this lifesaving skill and reach a city-wide standard.

Characterization of the auditory startle response in Fmr1 targeted mutant mouse models of fragile X syndrome

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Fragile X syndrome results from inadequate production of the fragile X mental retardation protein (FMRP) and shares significant neurobiology with autism spectrum disorder. Mice with a mutation targeted to the Fmr1 gene lack FMRP and thus are a valuable animal model for studying the behavioural and neural phenotype of this human disorders. Mice of two genetic backgrounds containing the Fmr1 mutation, C57BL/6J (C57-KO) and FVB/NJ (FVB-KO) differed significantly from control mice in behaviour in the elevated plus maze, the open field and the passive avoidance paradigm. Both the C57-KO and FVB-KO mice exhibited greater startle responses than normal mice to low intensity (80 dB) white noise bursts and decreased responses to high intensity (120 dB) white noise bursts. These behavioural alterations appear to be specific to the Fmr1 mutation since they are present on both genetic backgrounds. Furthermore, the mice lacking FMRP resemble individuals with fragile X syndrome and autism spectrum disorder in their increased sensitivity to low intensity auditory stimuli. In these studies, we will further characterize the auditory evoked response in these mice and how it can be affected by various amplitudes PPIs. These findings should prove useful in determining how the absence of FMRP alters the brain and behaviour, and in testing potential treatments for fragile X syndrome and autism spectrum disorder.

Exploring biological sex differences in therapeutic responses to non-invasive brain stimulation: A systematic literature review

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Non-invasive brain stimulation (NIBS) is a broad term consisting of electrical, magnetic or sonographic treatment practices for various conditions affecting the brain. Although the beneficial effects of NIBS have been proven across many studies, the influence of biological sex remains an understudied factor in the mechanisms that affect treatment outcomes. This systematic literature review aims to identify the sex differences in therapeutic responses to non-invasive brain stimulation (NIBS) in non-healthy human participants. Two independent review authors searched the literature on this topic using the OVID-MEDLINE database (1946-May 2024). Our findings indicate the presence of sex differences in the efficacy of treatment for unipolar or bipolar depression, pain disorders, post-traumatic stress disorder and Parkinson's disease treated with transcranial magnetic stimulation (TMS), tinnitus and binge-eating disorder treated with transcranial direct current stimulation (tDCS), and hallucinatory disorders treated with TMS and tDCS. Contrastingly, sex differences were not observed in the efficacy of treatment for obsessive-compulsive disorder treated with TMS as well as stroke treated with TMS and repetitive TMS (rTMS). This prompts researchers and clinicians to continue investigating the differing responses to brain stimulation between females and males with the aim of catering treatment in function of biological sex. The advancement of research in this field could permit NIBS methods to be implemented as a standard clinical practice. Additionally, this development will offer an opportunity to individuals who have not yet benefited from conventional treatments to manage their mental illnesses or medical conditions and expand our knowledge of the gender gap in this research.

Agricultural density and incidences of certain types of cancers in Ontario regions

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My research explores the correlation between agricultural land density and cancer index in Ontario. Motivated by my personal connections with affected individuals, the research aims to uncover potential links between agricultural pesticide use and increasing cancer rates. In this way, it highlights significant environmental and public health implications. What is the correlation between agricultural land density (km2 of agricultural land per km2 of total area) and cancer incidence in different regions of Ontario? I hypothesized that it would have a positive correlation. Assuming that regions with higher agricultural density may have potential exposure to agricultural practices with chemicals. I had collected agricultural data from OMAFRA, cancer incidence data from Cancer Care Ontario and Public Health Ontario. I had adjusted region consistency, calculated farmland density, and analyzed the correlation between farmland density and cancer incidence using Google sheets. The results show that there is no significant correlation between the density of agricultural land and the cancer rate per 100,000 inhabitants. The main factor influencing cancer rates is not land size. Smoking, alcohol consumption, unhealthy diet, physical inactivity and air pollution are often highlighted as main causes of cancer. My hypothesis was not disproven because I assumed that the higher density of farmland would lead to enough pesticide exposure to develop cancer. Next steps will be comparing cancer rates among farmers and rural (non-farmer) populations, examining toxin levels in water and soil, and using predictions to strengthen research.

The development of a nanomaterial-based electrochemical biosensor for early detection of Alzheimer's and Parkinson's diseases

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Neurodegenerative diseases like Alzheimer's and Parkinson's are marked by the accumulation of biomarkers such as beta-amyloid (Aβ) and alpha-synuclein (α-syn). Early detection of these biomarkers is critical for timely intervention before irreversible neuronal damage occurs. However, current diagnostic tools are inadequate for early detection, necessitating the development of more sensitive and specific diagnostic methods. I hypothesize that a gold nanoparticle-based electrochemical biosensor can detect Aβ and α-syn with exceptional sensitivity and specificity in blood and cerebrospinal fluid, facilitating early diagnosis of Alzheimer's and Parkinson's diseases. This research focuses on creating an electrochemical biosensor utilizing gold nanoparticles functionalized with antibodies specific to Aβ and α-syn. Gold is selected for its conductivity,

biocompatibility, and ability to enhance signal detection at the nanoscale, which is critical for achieving the high sensitivity required for early biomarker detection. The biosensor will detect biomarker binding through changes in electrical signals. The project involves sensor design, nanomaterial functionalization, and rigorous laboratory testing to evaluate sensitivity, specificity, and detection limits. To assess diagnostic accuracy, successful prototypes will be tested in clinical trials with high-risk individuals and healthy controls. The expected outcome is a biosensor with high sensitivity and specificity for detecting low concentrations of Aβ and α-syn in biological samples. This sensor could offer a non-invasive, rapid diagnostic tool, enabling earlier detection of neurodegenerative diseases than currently possible. The development of this biosensor would mark a significant advance in early neurodegenerative disease detection, potentially transforming early intervention strategies and improving patient outcomes. Future research will focus on validating the biosensor with clinical samples, optimizing it for practical use, expanding detectable biomarkers, and exploring applications in other disease areas, potentially extending its utility beyond neurodegenerative diseases.

Manipulative experiment: Minimalistic patient-centered label effect on patient comprehension of medicine

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Medication labels have always been the gateway for patients to receive instructions about their prescribed medicine. Most often, however, patients experience difficulty when interpreting the content due to the packed instructions, alongside with the small fonts labeled on their medicine. These can induce fear in patients due to interpretation difficulties. If worse, medication errors can occur and lead to unimaginable physical and mental trauma. For these reasons, adopting a minimalist design language on medication labels is crucial in enhancing patients' understanding and ensuring safety when taking their medications. As there is insufficient research on balancing the clear communication of medication instructions with the cognitive impact of the graphic design counterpart on patients, this experimental study aims to explore the effectiveness of a simplistic patient-centered drug label in minimizing drug errors while keeping the label's practicality in mind. Many products in modern-day society adopt a minimalist design with the motto "less is more" into their products because simplicity can highlight crucial information for users. Thus, we hypothesize that a simplistic patient-centered label design can improve patients' comprehension and prevent medication errors. The trial involves altering font size and spacing based on the information importance, categorizing medication intervals, and selecting distinct colors to represent each medicine, all while adhering to Canada's medication labeling regulations. This experiment targets alert and oriented patients with comorbidity in Canada as they have vast polypharmacy. The method will be to provide questionnaires to patients after reading the current and redesigned label to test their knowledge about the prescriptions. By improving the effectiveness of the drug label to better suit the patient, not only may this minimize any confusion caused by the current information label, but also potentially decrease patient anxiety. Ultimately, patients can improve their treatment experience in the long term.

The COVID-19 impact: Mental health wellbeing and academic performance on post-secondary students in Canada

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A highly contagious airborne disease resulting in the death of millions on a global scale, prolonged health conditions, and has dramatically impacted the livelihood of everyone. Lockdown procedures, mask mandates, and social distancing protocols were issued in order to isolate, prevent, and attempt to control this outbreak of the COVID-19 pandemic. The purpose of this study is to examine the effect of the COVID-19 pandemic on mental health symptoms and academic performance of post-secondary students in Canada before and during the lockdown. This research aims to raise awareness of the not only pre-existing difficulties and stressors of post-secondary education, but additional perplexing challenges brought forth by said unforeseen epidemic. This work provides a comprehensive overview of existing literature by summarizing and analyzing selected systematic, meta-analysis, cohort, and longitudinal studies. This work stems from a much larger study examining the changes, impacts, and other variables of students recruited from the University of Ottawa annually from 2017 to 2022. Previous research supplies evidence that individuals with pre-existing stressors or mental health conditions when faced with COVID-19-related stressors, would show significantly higher levels of prevalence for the onset of mental health symptoms, especially depression and anxiety. By identifying trends from the literature, it can be noted that there may be long-lasting effects on post-secondary students, not only on their mental health, but also on their academic performance. Mental health symptoms have been shown to be elevated to some degree and that these students face an enormous disruption in their day-

to-day lives, education, living situations, working conditions, socializing events, and other situations. It is imperative that higher education institutions allocate resources to recognize and address these increasing stressors to mitigate long-term symptoms on the wellbeing of their students.

Conflicts of Interest

The authors declare that they have no conflict of interests.

Authors' Contributions

GLT: served as President of CYM, reviewed abstract submissions to ensure proper formatting standards, assisted undergraduate authors with their submissions, drafted the CYM abstract, drafted and formatted the abstract booklet, and gave final approval of the abstract booklet to be published.
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