WRIGHT STATE UNIVERSITY

2025 Celebration of Undergraduate & Graduate Research, Scholarship, & Creative Activities

March 13, 2025

Wright State University Student Union

SCHEDULE OF EVENTS

Wright State University Student Union

8:30 a.m.	Check-in	Skylight Lobby
	Set Up • Posters • Sponsors • Colleges/Schools and Core Facilities	Apollo Room
9:00 a.m.	Celebration Begins • Opening Remarks – Sue Edwards, University President • Welcome – Madhavi Kadakia, Vice Provost for Research and Innovation	Endeavour Room
9:15 a.m.	Plenary Speakers • Winner of the Spring 2025 3MT/Honors Blitz Competition • Isabelle Fox– Perspectives of Medications for Opioid Use Disorder from Certified Peer Recovery Supporters in Dayton, OH: A Qualitative Study (BSOM) • Jean Paul Hakizakubana – Dividend Policy and Firm Value of the Companies Quoted at the Rwanda Stock Exchange (RSCoB) • Ibrahim Abdul Halim – Spinal Motor Neuron Excitability Changes in Aging (CECS) • George Diehl – Fostering Change Readiness in Military Support Organizations: The Role of Leadership Styles and Mediating Factors of Leader-Member Exchange and Public Service Motivation (CHEHS) • William Evans – The Foreigner in Our Midst: Jewish Rights Debates in Revolutionary France (COLA) • Robert Lysinger– A Study of Power Saturation in Spectroscopic Gas Analysis in the Terahertz Spectral Range (COSM)	
11:00 a.m.	Data Blitz Session • Araam Abboud – A Photovoice Exploration of the Perspectives of Global Health Learners on Reproductive Care (BSOM) Poster #42 • Niharika Annapureddy – Evidence that Ultraviolet B Radiation Generates Systemic Responses via Microvesicle Particle (BSOM) Poster #7 • Riya Patel – Replication Protein A Inhibitors as a Novel Strategy for Tumor Suppression (BSOM) Poster #32 • Harigovind Harikumar – Generative Adverserial Network, Motion Sickness Study (CECS) Poster #73 • Ashutosh Ghimire – A Golden-Free Hardware Trojan Detection using Unsupervised ML and On-Chip Localization (CECS) Poster #71 • Emily Martin – Elementary Teacher Candidates Learn about Project-based Learning (PBL) by Participating in a PBL Partnership with High School STEM Students (CHEHS) Poster #85 • Gabrielle Christner – Maritime Conflict and the Portrayal of Piracy in Early Modern Literature (COLA) Poster #87 • Angela Allen – The Impact of Ecologically Relevant and Irrelevant Stimuli on Groups of Earthworms in an Open-Field Environment (COSM) Poster #128	
12:00 p.m.	Lunch	
12:30 p.m.	Poster Session	Apollo Room
4:00 p.m.	Award Announcements – James Denniston, Acting Provost	Endeavour Room
4:30 p.m.	Conclusion	

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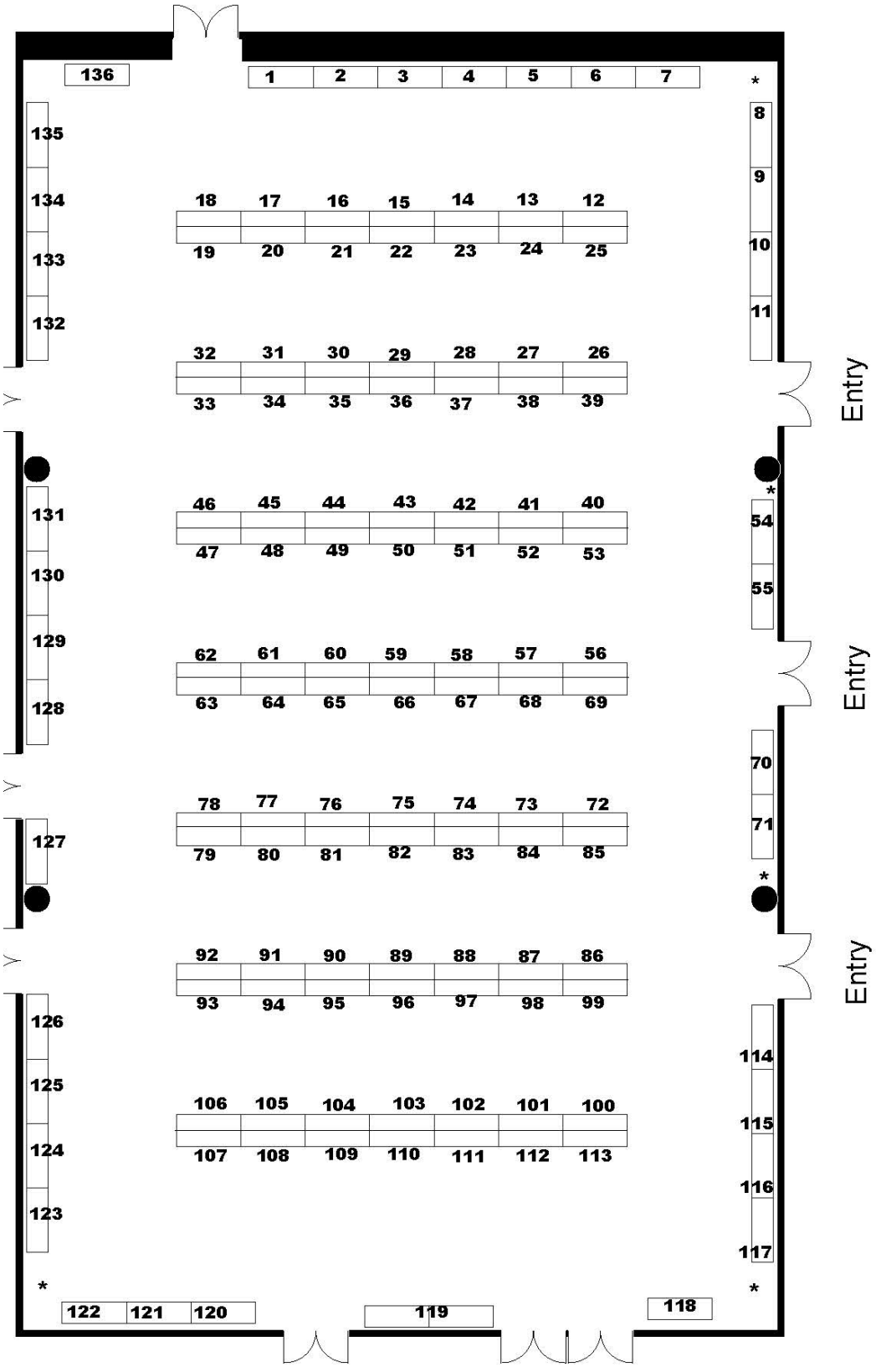
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Boonshoft School of Medicine

Department of Neuroscience, Cell Biology, and Physiology

1 Three-Dimensional Spinal Cord Modeling and Electrical Simulation

Tran, Catherine Thuy Tien

Mentor: Elbasiouny, Sherif

The human spinal cord is an organ of the central nervous system that plays a significant role in synthesizing and transmitting signals for essentially everything that we need to go about our day-to-day lives. In order to do so, the spinal cord contains a variety of neuronal cell bodies that process and produce signals along its entire length and branches. By studying how these neuronal cell bodies produce these signals, a better understanding of how neurodegenerative diseases such as amyotrophic lateral sclerosis (ALS) affect the signaling capacity of the nervous system at its foundational units could be reached. In this project, the firing activity and resulting electrical field and electric potential were simulated and measured using a three-dimensional spinal cord model and NEURON. The three-dimensional spinal cord was extensively constructed from the cervical to lumbar regions via healthy human MRI scans. Following 3D construction, the spinal cord model was subjected to electrode stimulation via virtual finite element analysis (FEM), producing an electrical field. The electric potentials from the resulting electrical field and their corresponding spatial coordinates (X, Y, Z) on the spinal cord model were then inputted into NEURON, which is a software that provides a motor neuron computational model, and the firing activity of the neuron was measured. By establishing and refining this process of modeling and stimulating a healthy three-dimensional spinal cord and its corresponding motor neurons, MRI scans from patients with neurodegenerative diseases can be utilized so that the faulty activity of location-specific motor neurons can be measured and analyzed in the future.

2 Downregulation of SK Channels in ALS: Insights from SOD1-G93A Mouse Models

Yap, Sau Qwan; Elbasiouny, Sherif
Mentor: Elbasiouny, Sherif

Amyotrophic lateral sclerosis (ALS) is a fatal neurodegenerative disease characterized by the progressive loss of motor neurons in the central nervous system that leads to paralysis and death. One hallmark of ALS is motor neuron hyperexcitability, highlighting the need to investigate potassium channels, which regulate neuronal excitability and action potential frequency. In this study, we aimed to determine the changes in the expression of small-conductance calcium-activated potassium (SK) channels in ALS mouse models. We hypothesized that the expression of SK2 and SK3 isoforms would be reduced in ALS-affected mice. To test this hypothesis, we collected lumbar spinal cords from male and female SOD1-G93A HC mice at P10, P30, P90 (symptom onset), and end stage disease timepoint, alongside age-matched wildtype controls. Western blot analysis revealed that the relative abundance of SK channels remained similar between groups at pre-symptom onset and symptom onset. However, we identified a significant reduction in SK2 and SK3 channel expression in ALS mice compared to controls at end stage disease timepoint, supporting our hypothesis. These findings suggest that SK channel dysregulation may contribute to motor neuron hyperexcitability in ALS and could serve as a potential therapeutic target.

Department of Obstetrics and Gynecology

41 Linking Neighborhood Factors, Racial Disparities, and Barriers to Care with Agency and Pathway Resilience Among Postpartum Women

Abboud, Araam; Wilcher, Katherine; Whitehead, Katie; Bute, Laura; Dhanraj, David; Talbot, Theodore; Maxwell, Rose

Mentor: Maxwell, Rose

Postpartum stress is shaped by various social determinants of health (SDoH), including neighborhood conditions, barriers to care, and racial disparities.1-3 We examined how these factors intersect to influence two distinct components of resilience—Agency (confidence in achieving goals) and Pathway (strategies to achieve goals)—among postpartum women. Methods: Surveys were collected from 109 English-speaking postpartum women (2017–2019), assessing demographics, barriers to care (e.g., finances, childcare, transportation), overwhelming stress, and resilience (Snyder's Hope framework). Publicly available zip-code data (crime rate, food desert, poverty) were matched for a subset (n=69) (Dayton Montgomery County Public Health, 2014). Statistical analyses (t-tests, ANOVA, Chi-square) explored how race and neighborhood factors influenced Agency and Pathway scores. Results: Overall, 56% of participants felt overwhelmed by stress. There were no racial differences in overall Agency or Pathway resilience scores. Stressed Black-identifying participants reported significantly higher transportation (p=.03) and financial (p=.03) barriers, while stressed white participants faced more childcare challenges.

3 Ectopic Pregnancy in the Broad Ligament: A Rare Presentation in a Low-Risk Patient

Stammen, Bailey Nicole; Torres, Roxanna
Mentor: Torres, Roxanna

Ectopic pregnancy occurs when a fertilized egg implants outside the endometrium, commonly in the fallopian tubes, cervix, ovary, or abdominal cavity. It poses a significant health risk to reproductive-aged women, accounting for 2% of reported pregnancies and being the leading cause of maternal mortality in the first trimester. Ectopic pregnancies in atypical locations, such as the broad ligament, present unique diagnostic challenges. This case report highlights an ectopic pregnancy in the broad ligament of a patient without common risk factors, emphasizing the necessity for heightened awareness and improved diagnostic strategies in recognizing these rare occurrences. Methods: We conducted a case study of a 29-year-old female G1P0 who presented with early symptoms of ectopic pregnancy, including a plateaued beta-hCG level. Ultrasound revealed blood in the endometrial cavity, but the location of the ectopic tissue was ambiguous. Results: Despite lacking identifiable risk factors—such as prior ectopic pregnancies, STIs, and endometriosis—the patient underwent laparoscopic surgery, revealing an ectopic pregnancy in the highly vascularized broad ligament. The surgical intervention was successful and uncomplicated. Post-operatively, the patient's beta-hCG levels dropped significantly, confirming complete removal of the ectopic tissue. Conclusions/Implications: This case emphasizes the importance of considering ectopic pregnancies in atypical locations, even in the absence of traditional risk factors. Early identification and enhanced diagnostic methods are crucial for improved outcomes. Future research should focus on refining diagnostic techniques and management strategies for unusual ectopic pregnancies, potentially influencing clinical guidelines.

Department of Pharmacology and Toxicology

4 Advances in Anti-Angiogenic Therapies for Non-Small Cell Lung Cancer: Exploring Apatinib and Combination Approaches

Addala, Anisha Vidyani; Thyagarajan, Anita; Sahu, Ravi
Mentor: Sahu, Ravi

Lung cancer, particularly non-small cell lung cancer (NSCLC), is the most prevalent and remains a major health challenge due to its high morbidity and mortality rates and poor 5-year survival. While numerous therapies such as chemotherapy, targeted therapy, immunotherapy, chemoradiotherapy, or a combination of these therapies exist for cancer treatment, they often have limited effectiveness. For example, conventional chemotherapeutic agents are often constrained by non-specific targeting, limited bioavailability, and the emergence of drug resistance, which collectively diminish their therapeutic efficacy. As tumour growth relies on a blood supply (i.e., angiogenesis), recent advances in anti-angiogenic combination therapies for advanced NSCLC include their integration with chemotherapy, targeted therapy, and immunotherapy. Apatinib (anti-angiogenic agent) is a tyrosine kinase inhibitor (TKI) that selectively inhibits the vascular endothelial growth factor-receptor 2 (VEGFR2). Many studies, including cell culture, animal models, and clinical studies have demonstrated the efficacy and safety of apatinib. Importantly, clinical studies demonstrate that apatinib significantly prolonged survival with higher doses (750 mg or 850 mg daily) showing better outcomes than lower doses. While apatinib is investigated in combination therapy for NSCLC to enhance treatment efficacy, the meta-analysis revealed some notable adverse effects such as hypertension, proteinuria, hand-foot syndrome, and diarrhoea, with no significant differences observed in myelosuppression or nausea. Importantly, apatinib's integration with other modalities, like camrelizumab (an anti-PD-1 antibody), has shown promise in converting unresectable stage II-III NSCLC to resectable tumors, demonstrating higher pathological response rates compared to chemotherapy alone. However, ongoing research is needed to address sample size limitations and validate predictive biomarkers such as TYROBP for optimizing patient outcomes. This review is to systematically evaluate the efficacy and safety of apatinib in treating NSCLC, emphasizing its potential in combination therapies and the identification of biomarkers to improve patient outcomes.

5 Functional Significance of miRNA-218 as a Potential Biomarker and Therapeutic Target in Lung Cancer

Aggarwal, Divyanshu; Thyagarajan, Anita; Sahu, Ravi
Mentor: Sahu, Ravi

Lung cancer, in particular non-small cell lung cancer (NSCLC), is one of the most fatal malignancies globally accounting for 20% of all cancer-related mortalities in 2024. This underscores the urgent need for advancements in its research with focus on identifying specific molecular players, such as microRNAs, which have been widely studied for their role in regulating gene expressions and their potential implications in cancer biology. Among them, microRNA-218 (miR-218) has drawn significant attention for its tumor-suppressive properties. Multiple studies have explored the potential of miR-218 as a key regulator of pathways required for tumor progression. In-vitro studies have demonstrated that miR-218 is involved in various key cellular processes such as proliferation, invasion, metastasis, and apoptosis. Furthermore, studies conducted in-vivo also highlight its impact on tumor suppression, with findings suggesting its role as both a biomarker and a therapeutic target. Additionally, clinical samples also indicate that lower miR-218 expressions are linked to higher cancer growth. By summarizing the latest experimental and clinical insights, this review provides an overview on the critical role of miR-218 in modulating pathways associated with lung cancer growth. Understanding the molecular mechanisms and clinical relevance of miR-218 could provide novel therapeutic strategies aimed at restoring its expression and improving patient outcomes.

6 Exploring the Mechanisms and Efficacy of Pioglitazone for Non-small Cell Lung Cancer

Aluru, Sravya; Sahu, Ravi; Thyagarajan, Anita
Mentor: Sahu, Ravi

Lung cancer is one of the top causes of cancer-related deaths worldwide. Approximately 3.2 million people are affected by lung cancer, with non-small cell lung cancer (NSCLC) being the most prevalent, accounting for 85% of all cases. NSCLC is marked by a complex genetic makeup, involving numerous driver mutations and epigenetic changes that drive tumor growth and resistance to treatment. Chemoprevention in high-risk populations, such as former smokers, offers a potential strategy to reduce lung cancer incidence and mortality. Among other approaches, thiazolidinediones, including pioglitazone that targets Peroxisome Proliferator-Activated Receptors- gamma (PPAR-γ) show promise in preclinical studies and in lung cancer patients with diabetes. In parallel, in vitro studies on NSCLC cell lines revealed that pioglitazone inhibits cell proliferation and invasion, and induced apoptosis. Importantly, mRNA profiling and protein analysis demonstrated that pioglitazone downregulates key cancer-associated pathways, including Mitogen-Activated Protein Kinase (MAPK), Myelocytomatosis oncogene (Myc), and Ras (Rat sarcoma), and impacted the Transforming growth factor beta (TGFβ)/ Small Mother Against Decapentaplegic (SMAD) signaling pathways, which play critical roles for epithelial-to-mesenchymal transition (EMT). Additionally, pioglitazone modulates cellular bioenergetics, reducing extracellular acidification rate and glucose metabolism markers. Moreover, the goal of this review is to highlight the mechanistic updates on PPAR-γ agonists with particular emphasis on the therapeutic potential of NSCLC.

7 Evidence that Ultraviolet B Radiation Generates Systemic Responses via Microvesicle Particles

Annapureddy, Niharika; Travers, Jeffrey B.; Rapp, Christine; Henkels, Karen; Wilferd, Prince; Begum, Muslima

Mentor: Travers, Jeffrey B.

UVB (Ultraviolet B) radiation, ranging from 280 to 315 nm, has been identified as carcinogenic since 1928 and is known to cause skin cancer. Additionally, UVB exposure triggers inflammatory responses, systemic effects, and organ damage. Recent research has discovered these adverse outcomes are facilitated by the release of microvesicle particles (MVP) via the inflammatory lipid platelet-activating factor (PAF). We have previously demonstrated that sunburn causes skin keratinocytes to release high levels of MVP by activating the PAF receptor. These studies were designed to test if these microvesicles enter the bloodstream and travel to various organs, especially the gut, increasing gut permeability with resultant bacterial translocation to the lymph nodes, leading to organ damage. In vitro studies with HaCaT cells treated with UVB showed increased MVP release compared to untreated cells, which was inhibited by functional inhibitors of the acid sphingomyelinase enzyme (FIASMAs) like imipramine. Similarly, UVB-treated C57Bl6 mice exhibited high levels of MVP, proinflammatory cytokines, neutrophilic inflammation in multiple organs, and increased bacterial translocation—all reduced by treatment with FIASMAs, PAFR-/-, or aSMase-/- mice. Furthermore, MVP release, bacterial translocation, and inflammation in XPA-/- (photosensitive) mice were prevented by treating them with imipramine. These studies provide evidence that PAF and MVP mediate inflammation and organ damage caused by UVB exposure and provide support for novel therapeutic strategies involving FIASMAs.

8 The Circadian Clock Modulating Compound SR8278 Slows Cell Proliferation Independent of REV-ERB

Atluri, Ushaswini; Cvammen, William; Kemp, Michael
Mentor: Kemp, Michael

The small molecule compound SR8278 was initially identified as an antagonist of the REV-ERB proteins, which play an important role in regulating circadian rhythms. Furthermore, the use of SR8278 in preclinical models has been demonstrated to ameliorate a variety of different pathologies. Using RNA-seq analysis of HaCaT keratinocytes treated with SR8278, our laboratory found that SR8278 induces a down-regulation of genes involved in the G1/S phase transition of the cell cycle and an up-regulation of genes involved in cholesterol biosynthesis. RT-qPCR and western blot analyses confirmed that SR8278 treatment led to lower expression of several factors involved in DNA synthesis at both the mRNA and protein levels, respectively. Treatment of HaCaT and other cell lines with SR8278 slowed cell proliferation in a dose- and time-dependent manner and was not associated with an induction of cell death. To determine whether the anti-proliferative effects of SR8278 were mediated by REV-ERBs, HaCaT cell lines lacking expression of both REV-ERBα and β were generated using CRISPR/Cas9 genome editing. Interestingly, both the single- and double-knockout cell lines displayed largely normal growth rates that were still inhibited by SR8278. We conclude that the effect of SR8728 on cell proliferation is not mediated by REV-ERBs.

9 Cutting Edge Advances in Neuroendocrine Carcinoma of Lungs

Balaga. Rathnamala
Mentor: Oroszi, Terry

Neuroendocrine tumors (NETs) of lung exhibits a various group of malignancies, starting from typical carcinoids (TC) to highly aggressive small-cell lung carcinoma (SCLC) and large-cell lung carcinoma (LCNEC). These tumors begin from neuroendocrine cells in the lungs and also, they present challenges to diagnosis which leads to delay in therapy. Whereas atypical carcinoids (AC) and TC express slow progression, SCLC and LCNEC are aggressive, distinguish by poor prognosis and rapid metastasis. Approximately 15% of lung cancer accounts for SCLC, it's extremely challenging due to its resistance to therapy and high relapse rate. Whereas LCNEC is uncommon but has molecular characteristics with both SCLC and non-small cell lung carcinoma (NSCLC), confusing diagnosis and therapeutic decision. TC and AC are slow-growing and often asymptomatic until they obstruct airways, leading to cough, wheezing, hemoptysis, or recurrent pneumonia. LCNEC and SCLC are aggressive, presenting with weight loss, dyspnea, or chest pain. Conventional treatment includes platinum-based chemotherapy in addition to radiation therapy. The treatment for tumors requires a multidisciplinary approach that combines surgical resection, chemotherapy, radiotherapy, immunotherapy, and targeted therapy with particular emphasis on platinum-based chemotherapy for these patients. Immunotherapy come up as a promising addition, specifically in SCLC. Targeted therapies, including BCL-2 antagonists and DLL3 inhibitors were being explored but have yet to achieve broad clinical success. Supportive therapy includes Trilaciclib, a CDK4/6 inhibitor, is administered before chemotherapy to reduce myelosuppression, thus preventing anemia, neutropenia, and thrombocytopenia. Localized NETs, surgical interventions remain the primary treatment, especially in initial stage carcinoid tumors and LCNEC. However, high recurrence rates highlight the requirement for improved systemic therapy. The improvement in molecular profiling recognizes genetic alterations that may led to future treatment or personalized therapy. This article summarizes the novel treatments for lung METs, with initial focus on emerging treatment. The therapy may expand by research advances in integrating molecular insights with clinical practice and may increases the prognosis of patient with complex tumors.

10 Efficacy and Safety of GLP-1 Agonists for Obesity in Children and Adolescents

Bandi, Sri Sai Sandeep; Elased, Khalid M.
Mentor: Elased, Khalid M.

Childhood and adolescent obesity is a growing global health concern, which requires multifaceted interventions beyond lifestyle modifications. Recent advances highlight the efficacy of pharmacotherapy, particularly glucagon-like peptide-1 receptor agonists (GLP-1 RAs), as adjuncts to lifestyle changes. Semaglutide and liraglutide, which are FDA-approved for adolescents ≥12 years, demonstrate superior outcomes in pivotal trials. In the STEP TEENS trial, a once-weekly semaglutide (2.4 mg) plus lifestyle intervention achieved a 16.1% reduction in BMI (vs. 0.6% placebo) and 73% of participants attained ≥5% weight loss (vs. 18% placebo), alongside cardiometabolic benefits. Similarly, in the SCALE Teens trial, liraglutide (3 mg daily) reduced BMI by 4.6% over 56 weeks, and 43% of the participants achieved ≥5% weight loss.

11 Combining Immunotherapy and Anti-Angiogenesis Approaches: Treatment of Advanced Non-Small Cell Lung Cancer

Barney, Tate; Thyagarajan, Anita; Sahu, Ravi P.
Mentor: Sahu, Ravi

Combining immune checkpoint inhibitors (ICIs) and anti-angiogenic pharmacologic agents is an encouraging therapeutic approach in the treatment of non-small cell lung cancer (NSCLC). This study aims to demonstrate the effects of nivolumab, a programmed death-1 (PD-1) inhibitor, and bevacizumab, a vascular endothelial growth factor (VEGF) inhibitor, in patients without sensitizing mutations in epidermal growth factor receptor (EGFR), anaplastic lymphoma kinase (ALK), or ROS proto-oncogene 1 (ROS1). Notably, the combination of nivolumab and bevacizumab shows encouraging results in patients with NSCLC with minimal adverse effects, respectively. Moreover, clinical trials have demonstrated that nivolumab and bevacizumab, when used in combination with platinum-based chemotherapy, significantly improve progression-free survival (PFS) and overall survival (OS) compared to chemotherapy alone. Additionally, pembrolizumab, another PD-1 inhibitor, has shown similar improvements in PFS and OS when combined with platinum-based chemotherapy, although its mechanisms differ from those of bevacizumab. However, further studies are needed to validate the therapeutic benefits of this immunotherapy and anti-angiogenic therapy combination in NSCLC patients.

12 Characterizing the Microvesicle Particles (MVPs) from Photodynamic Therapy (PDT)-Stimulated Cells

Begum, Muslima; Cool, David; Rapp, Christine M.; Henkels, Karen M.; Travers, Jeffrey B.
Mentor: Travers, Jeffrey B.

Photodynamic Therapy (PDT) has an important role in oncology. This methodology is a minimally invasive therapeutic approach that uses light-sensitive drugs (a photosensitizer e.g., 5-aminolevulinic acid; 5-ALA) and a specific light source to destroy cancer cells in cancerous actinic keratosis as well as superficial skin cancers. The exposure of lights activates the photosensitizing agent, triggering the production of singlet oxygen, which subsequently leads to the generation of additional reactive oxygen species (ROS), inducing oxidative stress and ultimately causing cell death. Many studies including from our group have demonstrated that PDT can cause immunosuppression in both mice and humans. Our lab's studies show that like other stressors such as UVB and thermal burns, PDT triggers the production of microvesicle particles (MVPs) containing high levels of Platelet-activating Factor (PAF) agonists in human and mouse cell lines. Of interest, murine studies have indicated that both local and systemic immunosuppression from PDT is dependent upon the MVP-generating enzyme acid sphingomyelinase. However, only systemic immunosuppression from UVB is MVP-dependent. The goal of these studies is to try to compare the contents of MVP derived from keratinocytes treated with either UVB or PDT to ascertain differences which could explain their distinct biological differences. We are using cytokine arrays and mass spectrometry-based lipidomics to ascertain inflammatory & immunosuppressive protein cytokines and the bioactive lipid profile of PDT-MVP & UVB-MVPs. These findings could provide important insights and potential pharmacological therapies to potentially augment the effectiveness and decrease the side effect profile of topical PDT.

13 DNA Replication Checkpoint

Bondili, Gowry Snehitha
Mentor: Xu, Yong-jie

DNA replication checkpoint (DRC), evolutionarily conserved in all eukaryotic organisms, ensures the fidelity of genomic duplication and prevents mutagenic chromosomal damage in the presence of replication stress. The DRC is activated as a response to replication stress, caused by multiple factors such as nucleotide scarcity, blockage of the replication fork, or damage to DNA templates. The key players in the DRC are ATR (Ataxia Telangiectasia and Rad3-related) kinase and its downstream target and the cell cycle regulator CHK1 kinase. Between ATR and CHK1 are the proteins that control the replication machinery and prevent premature mitotic entry. By slowing down the progress of the cell cycle, the DRC makes time for DNA replication to finish and DNA damage to be repaired, thereby preventing genomic destabilization. The abnormal operation of this process is responsible for replication-associated pathologies such as cancer, aging, and neurodevelopmental abnormalities, among others. Inhibitors of ATR and CHK1 have been developed that can be used in synthetic lethality, a recently developed therapeutic strategy for the treatment of cancer. Moreover, Single-cell barcoding and long-read nanopore sequencing allow researchers to accurately map genomic loci where each DNA polymerase molecule enters the stalled fork, helping us better understand the DRC signaling mechanisms. Furthermore, single cell nanopore sequencing can be used in precision medicine and the identification of biomarkers. This technology, combined with computational modeling and pharmacological intervention with checkpoint inhibitors, makes it possible to understand comprehensively how single cells react to replication stress.

14 Urinary Angiotensin Converting Enzyme 2, Neprilysin, and ADAM17 as Early Biomarkers of Diabetic Kidney Disease

Bostick, Nadia; Gutta, Sridevi; Grobe, Nadja; Osman, Hassan; Saklayen, Mohammad G.; Elased, Khalid M.

Mentor: Elased, Khalid M.

The metalloproteases ACE2 and neprilysin (NEP) are implicated in the conversion of angiotensin (1–7) from angiotensin II (Ang II) and angiotensin I, respectively. Angiotensin (1–7) is a renoprotective peptide with anti-inflammatory, and antifibrotic properties, counteracting the detrimental effects of angiotensin II (Ang II). ACE2 and NEP enzymes are predominantly found in the renal proximal tubules and are thought to play a role in chronic kidney disease (CKD). Previous research has shown an increase in urinary ACE2 in individuals with diabetes, CKD, and kidney transplants, highlighting its potential as a biomarker. This study aimed to investigate whether urinary ACE2, NEP, and a disintegrin and metalloproteinase 17 (ADAM17) are elevated in patients with diabetes and could act as early indicators of CKD. Out of a total of 60 subjects, 20 were healthy nondiabetic (ND) subjects and 40 diabetic subjects, categorized into normoalbuminuria (Dnormo), microalbuminuria (Dmicro), and macroalbuminuria (Dmacro) groups. The levels of ACE2, NEP, and ADAM17 in each subject were quantified using ELISA, Western blotting, fluorogenic assays, and mass spectrometry. Logistic regression modeling was applied to assess risk, and receiver operating characteristic (ROC) curves were used to determine the accuracy of ACE2 and NEP in predicting CKD. The results revealed that ACE2 and ADAM17 were not detectable in the urine of ND subjects, but both enzymes were significantly elevated in diabetic patients, including those with Dnormo. Plasma ACE2 activity was absent, while NEP was detectable in both urinary and plasma samples in all groups, with a notable increase in urinary NEP levels in Dmicro patients. Strong correlations were observed between NEP and ACE2 levels and various metabolic and renal parameters. In conclusion, elevated urinary ACE2, NEP, and ADAM17 in diabetic patients could be used as early biomarkers to predict the development or progression of CKD in individuals with type 2 diabetes.

15 Why is Bacterial Meningitis on the Rise?

Brown, Ceon Coranek Rayanne; Sulentic, Courtney
Mentor: Sulentic, Courtney

The recent trend of increased incidence of bacterial meningitis is a growing cause for concern. The increase in cases is alarming due to the severity of the outcomes linked to the bacterial meningitis infection. The World Health Organization reports that 1 in 6 people die and 1 in 5 develop life-long acute complications from bacterial meningitis. The Center for Disease Control and Prevention recorded 438 cases in 2023, which is the highest observed since 2014. Neisseria meningitidis Serogroup Y was the main cause of the recent cases. Additionally, strain ST-1466 was identified in approximately 68% of all Serogroup Y cases. The purpose of the current project is to conduct a literature review focused on the following questions. 1) Is there an established link between the overall increase in cases and Serogroup Y? 2) If so, is there a competitive advantage of Serogroup Y compared to others (i.e. immune response, genetic differences)? 3) Are there other factors like vaccination rates, which may contribute to this increase? A comprehensive literature review and analysis of public health records focused on answering these questions will test the hypothesis that a combination of bacterial resistance, decreased efficacy of current vaccines, and decline in vaccination rates contribute to the increase in cases of bacterial meningitis. Providing more information on possible reasons for the growing numbers of cases can facilitate treatment and prevention of bacterial meningitis

16 Reducing Ultraviolet B Light-Induced Redness in Rosacea with Topical Imipramine and Amitriptyline

Bryant, Jade; Owens, Winston; Fisher, Garrett; Owens, Madison; Rohan, Craig; Travers, Jeffrey
Mentor: Travers, Jeffrey B.

Rosacea is a chronic inflammatory condition with limited therapeutic options. It is typically exacerbated by stimuli such as sunlight and alcohol use. Functional inhibitors of acid sphingomyelinase (FIASMs) such as amitriptyline and imipramine have been shown to inhibit the production of microvesicle particles (MVPs) which are membrane-bound mediators of cell signaling and biological activity. It is hypothesized that FIASMs, through their ability to inhibit the release of MVPs, may reduce the erythema response associated with ultraviolet B light exposure in rosacea patients. Type of Study: This study was conducted as a single-center, double-blinded, placebo-controlled randomized clinical trial. Methods: Patients with rosacea and non-rosacea controls were recruited, de-identified, and then randomized to receive 4% amitriptyline or 4% imipramine on either the left or right side of their face and a placebo medication on the other. Baseline erythema, photography, pain, and itch measurements were taken. Respective topical medications were applied, then 300Joules/m2 of artificial UVB light was administered and subsequent measurements were taken after UVB administration at 10 min, 60 min, 120 min, and 24 hours. Results: UVB-induced erythema in patients with rosacea had a statistically significant reduction from baseline in 4% topical amitriptyline and 4% imipramine compared to vehicle (one-tailed t-test, p= 0.043). Conclusion: Topical FIASMs such as amitriptyline and imipramine work by blocking the release of microvesicle particles and thus reducing the erythema associated with rosacea. These medications may serve as an adjunct treatment to UVB exposure in rosacea patients without adverse events or safety concerns.

17 The Role of miR-340 in Lung Cancer: Current Understanding and Future Directions

Chauhan, Mittalkumari Shivsinh; Thyagarajan, Anita; Sahu, Ravi P.
Mentor: Sahu, Ravi P.

Lung cancer is the second most prevalent malignancy in the world associated with the highest number of cancer-related mortalities. The most prevalent type of lung cancer is non-small cell lung cancer. The current therapeutic options include targeted therapy, chemotherapy and immunotherapy and a combination of these therapies. However, often such treatments are associated with a number of challenges, including tumor resistance, which limit the efficacy of therapeutic agents. Thus, investigation of new strategies is needed to overcome tumor resistance mechanisms and improve the efficacy of therapeutic agents. Among various ongoing approaches, implication of microRNAs has been explored due to their ability to regulate cellular pathways involved in supporting tumor growth. To that end, miR-340 has been shown to have tumor suppressor function in NSCLC. Multiple studies have shown that miR-340 targets several oncogenesis pathways including, SOX2 (sex-determining region Y-box 2), ZNF503 (zinc finger protein 503), Cyclin D1, NET1 (Neuroepithelial cell transforming 1) to regulate the growth of NSCLC. miR-340 has also been shown to increase the efficacy of therapeutic agents. This current study highlights the recent findings on the role and mechanisms of miR-340 in regulating cancer cell proliferation, metastasis, tumor resistance, and the efficacy of therapeutic agents.

18 Nanoparticle-based Lung Cancer Therapy with Curcumin

Dhengale, Shreya Manohar; Sahu, Ravi P.; Thyagarajan, Anita
Mentor: Sahu, Ravi P.

Lung cancer is one of the leading causes of global mortality, primarily attributed to tobacco smoking. Conventional treatments such as chemotherapy and radiotherapy are often ineffective in advanced stages due to their non-selective nature, causing severe side effects, drug resistance, and damage to healthy tissues. Furthermore, late-stage diagnosis complicates treatment efforts. Curcumin, the primary active compound in turmeric (Curcuma longa), has demonstrated significant potential in cancer therapy by inducing apoptosis, inhibiting metastasis, and reducing drug resistance in tumor cells. However, curcumin's clinical efficacy has been limited by poor bioavailability, attributed to its low absorption, rapid metabolism, and quick elimination. Recent advances in formulation techniques, such as nanoparticle and liposomal encapsulation, have enhanced curcumin's bioavailability, making it more effective in treating cancers and other diseases like arthritis and Alzheimer's. Nanoparticles (NPs) provide a promising solution to the limitations of traditional treatments by selectively targeting cancer cells while sparing healthy tissues. Green-synthesized nanoparticles, derived from medicinal and marine plants, offer a sustainable and cost-effective approach, enhancing therapeutic outcomes. These nanoparticles induce apoptosis, disrupt cancer cell membranes, and generate reactive oxygen species (ROS), leading to oxidative stress and cell death. Phytochemicals like flavonoids and alkaloids, used in nanoparticle synthesis, further boost cancer cell death by inhibiting critical signaling pathways, including phosphoinositide 3-kinase/protein kinase B/mammalian target of rapamycin (PI3K/Akt/mTOR), mitogen-activated protein kinase (MAPK), and Janus kinase/signal transducer and activator of transcription (JAK/STAT). Further research is required to optimize nanoparticle synthesis and targeting mechanisms to harness their potential in clinical applications. This study highlights the therapeutic synergy of curcumin and nanotechnology in developing novel, targeted treatments for lung cancer.

19 Safety and Efficacy of SGLT-2 Inhibitors in Chronic Kidney Disease and Heart Failure

Gamit, Alvishaben Pravinbhai
Mentor: Elased, Khalid M.

Sodium-glucose co-transporter-2 (SGLT-2) inhibitors, initially developed for glycemic control in type 2 diabetes, have demonstrated profound benefits in chronic kidney disease (CKD) and heart failure (HF), independent of glucose-lowering effects. Clinical trials such as EMPA-REG OUTCOME, CANVAS, and DAPA-HF have revealed substantial cardiovascular (CV) and renal benefits. In DAPA-HF, dapagliflozin reduced the risk of worsening HF or CV death by 26% (HR 0.74; 95% CI: 0.65–0.85), while EMPEROR-Reduced demonstrated a 25% reduction in combined HF hospitalization and CV death with empagliflozin (HR 0.75; 95% CI: 0.65–0.86). These benefits extend to patients with heart failure (HF) with a reduced ejection fraction (HFrEF) and preserved ejection fraction (HFpEF), irrespective of diabetes status. In CKD, the DAPA-CKD trial showed that dapagliflozin reduced the risk of sustained decline in eGFR, end-stage kidney disease (ESKD), or renal/CV death by 39% (HR 0.61; 95% CI: 0.51–0.72) in patients with and without diabetes. EMPA-KIDNEY confirmed similar benefits, with a 28% reduction in the composite renal outcome (HR 0.72; 95% CI: 0.64–0.82). These outcomes are attributed to mechanisms such as reduced intraglomerular pressure, natriuresis, and mitigation of inflammation and fibrosis. Despite these benefits, concerns regarding potential adverse effects, such as genitourinary infections, euglycemic ketoacidosis, and volume depletion, necessitate careful patient selection and monitoring. However, the overall risk-benefit profile remains highly favorable, positioning SGLT-2 inhibitors as a cornerstone therapy in modern cardiology. Future research aims to elucidate their full potential in diverse cardiovascular conditions and refine therapeutic strategies for optimal patient outcomes.

20 Synthetic Nucleoside Labels for Studying Cell-free DNA

Guragai, Dibya; Kemp, Mike; Carpenter, Alex
Mentor: Kemp, Mike

Synthetic nucleoside labels for studying cell-free DNA Cell-free DNA (cfDNA) is released from dying cells and is present in the circulation in association with extracellular vesicles or as other macromolecular complexes. This cfDNA is thought to be involved in intercellular communication and immune responses and is used clinically for diagnostic purposes through the use of PCR and DNA sequencing. Our laboratory has also used immunological detection methods to detect DNA lesions present in cfDNA following treatment of cells with various DNA damaging agents. Because some of the methods for detecting cfDNA are time consuming, expensive, and unable to detect low amounts of cfDNA, new methods of cfDNA detection are needed. Using the nucleoside analogs BrdU (bromodeoxyuridine), EdU (5-ethynyl-2'-deoxyuridine) and F-ara-EdU (2-deoxy-2-fluoro-5-ethynyluridine) to label cellular genomic DNA, we found that EdU provided the greatest ability to detect cfDNA. Though EdU is widely used to monitor DNA synthesis and to serve as a marker for DNA, we found that prolonged labeling of cells with EdU results in apoptosis. Our ongoing studies involve the use of EdU to study the release of cfDNA following different types of cell death.

21 Progress and Advancement in the Nanotechnology and Nanomedicine to Cure and Treat the Cancer

Kewat, Sandeep; Oroszi, Terry L.
Mentor: Oroszi, Terry L.

Advancements in nanotechnology and nanomedicine are bringing new hope to cancer patients by making treatments more effective and personalized. Researchers are using nanoparticles that can navigate the body's complex system to create smarter drug delivery methods. These nanoparticles can target cancer cells precisely, boosting the effectiveness of treatments while reducing harmful side effects. Different types of nanoparticles, like gold, silver, quantum dots, liposomes, dendrimers, and magnetic nanoparticles, are being used to deliver drugs directly to tumors. This targeted approach not only makes treatments safer but also more comfortable for patients. Nanotechnology is also improving cancer diagnosis. With advanced tools like biochips and nanoarrays, doctors can detect cancer earlier and more accurately, increasing the chances of successful treatment. A powerful new approach called Theranostics is changing the way cancer is treated. It combines therapy and diagnosis into one system, allowing doctors to treat cancer and monitor the treatment's progress in real time. This means treatments can be adjusted to fit each patient's unique needs, making them more effective and personalized. PhotoImmunoNanoTherapy (PINT) is another exciting development. It uses light, the body's immune system, and nanoparticles to find and destroy cancer cells without harming healthy tissue. This method also strengthens the body's natural defenses against cancer, reducing the risk of recurrence. Nanotechnology is paving the way for truly personalized cancer care by designing treatments based on an individual's genetic profile and is transforming cancer treatment and giving patients new hope for the future.

22 Impact of Hormonal and Environmental stressors on antibody production in IgH polymorphic B-Cells

Kirloskar, Karen Prarthana; Bhakta, Mili; Rachakonda, Venkata Sailaja; Sulentic, Courtney E.W.; Virani. Eimaan

Mentor: Sulentic Courtney E.W.

B cells secrete antibodies, which play a primary role in mediating immune responses against extracellular pathogens. The immunoglobin heavy chain (IgH) gene is responsible for expressing all antibody isotypes, each having different effector functions. Environmental and genetic factors could influence IgH expression and significantly affect human health. A large transcriptional regulatory region within the human IgH gene is polymorphic, which may lead to altered antibody production in response to environmental and biological factors. We developed a human B-cell line model that exhibits the genetic variations associated with the IgH polymorphism. Our overall objective is to use this model to evaluate the effect of environmental chemicals under different hormonal conditions on antibody production. Current studies are focused on evaluating the concentration-dependent effect of sex hormones on antibody production. Altered sensitivity of antibody production due to the IgH polymorphism could improve risk assessment by identifying vulnerable populations and perhaps lead to therapeutic interventions for antibody-mediated diseases.

23 Checkpoint Regulation of the Cell Cycle

Kondreddy, Lakshmi Lavanya
Mentor: Xu, Yong-jie

Cell cycle checkpoints are surveillance mechanisms that ensure each cell cycle stage is properly completed before moving on to the next stage. They are essential regulatory systems for maintaining genomic integrity and cell survival, particularly in the presence of DNA damage and replication stress. During cell proliferation, the transition from the G1 phase to the S phase of the cell cycle is crucial for the cell to start DNA replication and thus commit to a new cell division cycle. The checkpoint during the G1/S transition monitors DNA damage and plays a critical role in regulating cell fate. When cells commit to the S phase and start DNA replication, the replication checkpoint becomes functional to ensure the chromosomal DNA replication is properly finished before cell division. Similarly, the G2/M checkpoint ensures that DNA damage has been properly repaired before undergoing mitosis. During mitosis, the spindle assembly checkpoint ensures proper chromosome segregation and malfunctioning of this checkpoint leads to aneuploidy and carcinogenesis. The cell cycle checkpoints are regulated by classical checkpoint regulators, including p53, CDKs, ATM/ATR, and CHK1/CHK2. Malfunctioning of these regulators results in genomic instability and the development of many diseases, including neurological disorders and cancer. Recent discoveries suggest more complex regulation of the cell cycle checkpoints, such as metabolic signaling, epigenetic changes, and non-coding RNAs. It has been shown that in addition to cancer and neurological diseases, checkpoint dysregulation affects aging and stem cell maintenance. These discoveries challenge the conventional theory of cell cycle regulation and newly developed technologies may pave the way for future investigations.

24 Keloid Scars

Maisuriya, Riya
Mentor: Oroszi, Terry

Keloid scars are a complex dermatological disorder caused by excessive fibroblast activation, aberrant collagen deposition, and prolonged inflammation, resulting in elevated, hard scars that extend beyond the primary incision. Keloids, unlike hypertrophic scars, do not go away with time and present substantial therapeutic and management issues. Genetic predisposition is important, and it is more common among people of African, Asian, and Hispanic origin. Burns, surgical wounds, acne, and piercings are among environmental stressors that contribute to keloid formation. Keloids are caused by dysregulation of TGF-β, chronic inflammation, and imbalanced extracellular matrix (ECM) remodeling. This causes increased collagen production and reduced breakdown, supporting a pro-fibrotic environment. Keloids induce discomfort, pruritus, and psychological anguish in clinical settings, lowering quality of life significantly. Silicone gel sheeting, corticosteroid injections, and pressure therapy are some of the current management techniques. Nonsurgical treatments such as cryotherapy, laser therapy, and intralesional injections of corticosteroids, 5-fluorouracil, or bleomycin try to minimize scar size and symptoms. While surgical excursion is helpful for big keloids, it has a high recurrence rate unless accompanied by adjuvant therapy such as radiation or pressure garments. Emerging treatments, such as gene therapy, stem cell therapy, and immunomodulators, provide promise for tailored interventions that address the underlying processes of keloid formation. Despite improvements, keloid treatment remains difficult due to high recurrence rates, treatment resistance, and varying patient responses. A multidisciplinary strategy that incorporates innovative medications and tailored treatment strategies is critical to improve outcomes. This review delves into biology, clinical symptoms, and emerging therapeutic methods for keloid scars, emphasizing the need for novel, evidence-based approaches to improve patient care. Keywords: keloid scars, aberrant wound healing, excess collagen, TGF-β, chronic inflammation, fibroblast activation, molecular pathways, targeted therapy, combination treatment, multidisciplinary care.

25 Comparative Effects of Canagliflozin and Pioglitazone on Biomarkers of Diabetic Kidney Disease in db/db Mice

Minikuri, Siri Chandana; Thanekar, Unmesha; Gill, Rupinder K.; Elased, Khalid M.
Mentor: Elased, Khalid M.

Diabetes is a leading cause of chronic kidney disease (CKD) and progression to end-stage renal disease. Previous studies showed elevated urinary angiotensin-converting enzyme 2 (ACE2) levels in diabetic db/db mice, which were normalized with PPAR-γ agonists like rosiglitazone. Sodium-glucose co-transporter 2 (SGLT2) inhibitors, such as canagliflozin, lower glucose by inhibiting renal glucose reabsorption, inducing glycosuria. This study compared the effects of canagliflozin and the PPAR-γ agonist pioglitazone on urinary and renal ACE2, and ADAM17, along with albuminuria and renal injury markers such as neutrophil gelatinase-associated lipocalin (NGAL), arginase-II, and sirtuin-1 (SIRT1). Six-week-old db/db and lean control mice were treated with chow supplemented with canagliflozin or pioglitazone (20 mg/kg/day) for 15 weeks. Weekly metabolic and renal assessments included measuring glycosuria, protein expression, and enzyme activity. Diabetic db/db mice exhibited augmented hyperglycemia, increased renal ADAM17, Arginase II and decreased Sirt1. In addition, they showed increased urinary ACE2, and NGAL levels. Both treatments significantly reduced blood glucose.

26 Species-Specific Differences in AhR-Mediated Regulation of the 3' Immunoglobulin Heavy Chain Regulatory Region

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Mentor: Sulentic, Courtney

The 3’ immunoglobulin Heavy Chain Regulatory Region (3’IghRR) plays a role in antibody production by controlling Igh gene expression and class switch recombination (CSR). Recent studies have shown that TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin) interacts with the Aryl Hydrocarbon Receptor (AhR) to alter Igh gene regulation. However, species-specific differences in IgH gene structure and AhR function complicate our understanding of this process. The mouse 3’IghRR consists of a single regulatory region containing four enhancers (hs3A, hs1.2, hs3B, hs4), whereas the human 3’IGHRR is duplicated, with each copy containing three enhancers (hs3, hs1.2, hs4). These structural variations may contribute to differences in regulatory mechanisms between species. The objective of this study is to evaluate the effect of AhR activation on the transcriptional activity of the 3’IgHRR and its associated enhancers (hs3, hs1.2, hs4) by using luciferase gene reporters transfected into either a mouse or human B-cell line. In a mouse B-cell line, TCDD exposure inhibited the activity of both the 3’IghRR and the hs1.2 enhancer but increased the activity of the hs4 enhancer. In contrast, in a human B-cell line, TCDD increased hs1.2 enhancer activity, and this effect occurred independently of the AhR transactivation domain (TAD). This suggests that AhR can regulate the human hs1.2 enhancer through a non-canonical pathway, where transcriptional activation occurs without direct AhR-DNA binding at dioxin response elements (DREs). Instead, AhR may exert its effects through protein-protein interactions with other transcriptional factors or by influencing the enhancer activity via indirect interaction of co-regulators. Given the major structural and functional differences between the mouse and human 3’IgHRR enhancers, these findings suggest species-specific differences in IgH gene regulation and antibody production. Understanding these differences is critical for assessing human immune system vulnerabilities to environmental exposures. Keywords: Aryl hydrocarbon receptor (AhR), IgH expression, species-specific differences, transactivation domain (TAD), non-canonical AhR pathway.

27 Systemic Review on Repurposing of Diphenhydramine in Various Cancer Models

P U, Dipinkumar; Thyagarajan, Anita; Sahu, Ravi P.
Mentor: Sahu, Ravi P.

Drug repurposing has emerged as a promising strategy, leveraging existing pharmacological data to identify new therapeutic avenues. Diphenhydramine (DPH), a first-generation antihistamine, works by antagonizing the H1 (histamine 1) receptor, although it also has other mechanisms of action. In addition, DPH exerts diverse biological effects beyond its conventional role in allergy management, like dystonias, insomnia, pruritis, urticaria, vertigo, motion sickness, and Parkinson's disease. However, due to its ability to target multiple signaling cascades, many studies have used DPH in oncology, revealing its impact on multiple cancer types through various mechanisms: 1) DPH has shown potential in cross-resistance of cisplatin by inhibiting ATP-binding cassette (ABC) transporters (Drug efflux pump) like MDR2,3&5, thereby enhancing the efficiency of DNA Platination in chemotherapy; 2) In melanoma, it induces apoptosis via suppressing the STAT3/MCL-1 survival signaling; 3) In colon cancer, it suppresses interferon-gamma (INF-γ) and interleukin-2 (IL-2) production in murine splenocytes; 4) Additionally, in experimental models of colonic carcinogenesis, DPH reduced tumor incidence; 5) Moreover, in the case of 1,2-O-tetradecanoylphorbol-1,3-acetate (TPA)-induced tumor progression, DPH suppressed TPA-induced inflammation and tumor progression; 6) In trophoblast-derived choriocarcinoma cells, DPH stimulated extracellular vesicle (EV) release through TAS2R14 receptor activation;. 7) Furthermore, DPH showed neurocarcinogenic potential in long-term toxicity studies in rats, and, 8) Interestingly, it has been demonstrated that DPH increased the efficacy of platinum-based chemotherapy simultaneously reducing the toxicity associated with the same treatment. Additionally, DPH has shown its potential in managing the major side effects of chemotherapy (e.g., cisplatin) like nausea, vomiting & kidney toxicity. The current study highlights the mechanistic insights of DPH in various cancer models with the overall goal of evaluating its effects on the efficacy of chemotherapy.

28 Aryl Hydrocarbon Receptor-Mediated Regulation of IGH Transcription and Antibody Production: Insights from CRISPR-Edited Human B Cells

Pallikaranai Venkatesaprasath, Shakthidevi; Nedumaran, Uma Maheswary; Bhakta-Yadav, Mili; Sulentic, Courtney

Mentor: Sulentic, Courtney

Insights from CRISPR-Edited Human B Cells -The immunoglobulin heavy chain (IGH) locus, which encodes the heavy chain of antibodies, is tightly regulated during B-cell development and class switch recombination (CSR). In animal models, the environmental contaminant 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) potently inhibits antibody production. This inhibitory effect is mediated by the aryl hydrocarbon receptor (AhR). Our recent studies have identified a differential effect of TCDD on antibody production. The role of the AhR in this effect is unclear. Previous research has shown that AhR is necessary for IgG secretion, with AhR knockout leading to a loss of IgG production in human B cells. However, it is unknown whether AhR regulates IGH expression directly or through interactions with other transcription factors. To investigate whether the AhR is necessary for TCDD-mediated changes in IGH expression and antibody production, CRISPR/Cas9 gene editing is being utilized to generate an AhR knockout (AhR KO) human B-cell line (CL-01AhR KO). This approach will determine whether AhR is required for TCDD-induced suppression of antibody production and assess whether AhR has a physiological role in regulating IGH expression in the absence of environmental toxicants. This study aims to provide insights into the molecular mechanisms by which environmental toxicants influence IGH expression and antibody production, ultimately enhancing the understanding of the human immune system susceptibility to environmental exposures. Keywords: Aryl hydrocarbon receptor (AhR), immunoglobulin heavy chain (IGH), transcriptional regulation, CRISPR/Cas9, TCDD, immune system regulation.

29 The Role of DNA Damage Checkpoints in Maintaining Genomic Integrity

Panchal, Anjali Rohitbhai
Mentor: Xu, Yong-jie

DNA damage checkpoints are essential monitoring systems that identify DNA damage, stop the cell cycle, and regulate repair pathways for preserving genomic stability. At important cell cycle transitions (G1/S, intra-S, and G2/M), these checkpoints activate via signaling cascades mainly controlled by the ATM/Chk2 and ATR/Chk1 pathways. Genomic instability based on by defective checkpoint oversight causes aging, cancer, and neurodegenerative disorders. This review compares the role of these three-cell cycles. More recently, research has focused on improving synthetic lethality procedures, recovering checkpoint function with CRISPR-based approaches, and targeting checkpoint proteins for cancer treatment. Future research will modify these strategies to enhance genome maintenance strategies and precision medicine.

30 Targeting DNA Replication Stress: A New Frontier of Cancer Chemotherapy

Parmar, Shitalben Bharatbhai
Mentor: Xu, Yong-jie

Cancer cell is the result of abnormal growth of normal cell, and DNA replication is the biological process in which cell produce identical copy of parent cell and has same genome ability like their parent cell. A situation known as DNA replication stress (DRS) is one in which the normal process of DNA replication is hampered, It happens due to many reasons such as oncogene activation, nucleotide depletion, replication-transcription conflicts, or a deficient DNA repair system. DNA Replication stress is main hallmark of cancer cell. The outcome is fork stalling, fork collapse, and double-strand breaks. While normal cell can easily manage replication stress, cancer cell is highly susceptible with replication stress because proliferation of cancer cell is rapid. And this can give opportunity to target only cancerous cell rather than normal cell. In normal therapeutic effect of any cancer medicine has side effect of damaging normal cell also while destroy cancer cell. But this technique is useful to distinguish between normal and cancer cell and selectively targeting tumor cell. In this review mostly focus on strategies to increase DRS in cancer thermotherapy and the agent which help to exaggerate the DRS like WEE1, CHK1 and ATR inhibitor. Additionally, this review also focused on the combination therapy in that this inhibitor combines with traditional cancer chemotherapy to treat and inhibit cancer cell growth and kill. By this combination therapy it become new frontier in cancer chemotherapy, which is ultimately enhancing efficacy in order to minimizing resistance. However, there are many challenges such as overcoming resistance and identify the biomarkers and toxicity require further research to optimize clinical outcomes of this combination therapy.

31 Identification of suc22-S239F Suppressors Conferring Hydroxyurea Resistance and DNA Replication Checkpoint Activation

Pasam, Sairam; Xu, Yong-jie
Mentor: Xu, Yong-jie

The DNA replication checkpoint pathway is a critical regulatory mechanism ensuring genomic integrity during cell division. In Schizosaccharomyces pombe, the suc22 gene, encoding the ribonucleotide reductase small subunit, plays a pivotal role in this pathway. Mutations such as suc22 S239F disrupt this process, leading to hydroxyurea (HU) sensitivity and impaired checkpoint activation. Our study employed a genome-wide mutagenesis approach to identify suppressors of the suc22 S239F mutation that restore checkpoint functionality and HU resistance. Using N-methyl-N'-nitro-N-nitrosoguanidine (MNNG) mutagenesis, suppressor strains were generated and screened for HU resistance. Western blot analysis confirmed the presence of CDS-tagged proteins in these strains, indicating successful suppression. These strains were purified, backcrossed with wild-type strains, and intercrossed to classify them into distinct linkage groups. Whole-genome sequencing was employed to pinpoint the suppressor mutations responsible for rescuing the S239F phenotype. This study addresses key challenges, such as the risk of primary mutation loss post-mutagenesis and confounding effects of selectable markers like ura. Results are expected to provide insights into novel suppressors and elucidate pathways compensating for ribonucleotide reductase dysfunction. These findings contribute to understanding the molecular basis of DNA replication checkpoint regulation and open avenues for genetic and biochemical exploration of suppressor mechanisms.

32 Replication Protein A Inhibitors as a Novel Strategy for Tumor Suppression

Patel, Riya Amrishkumar
Mentor: Xu, Yong-jie

Replication Protein A (RPA) is ssDNA protein which is essential for DNA replication, repair, recombination, and telomere maintenance. HAMNO, a selective RPA70 inhibitor, significantly reduces cancer cell viability in a dose-dependent manner, with 40 μM causing nearly complete cell death. In nasopharyngeal carcinoma, HAMNO enhances with autophagy inhibition reducing cell viability by an additional 30%. Flow cytometry and γH2AX staining indicate that HAMNO-treated cells accumulate in the S-phase, exhibiting increased replication stress and chromatin-bound RPA levels. TDRL-551, an optimized derivative of TDRL-505, exhibits a two-fold increase in cytotoxicity, reducing lung and ovarian cancer cell viability by approximately 60% at 10 μM. Western blot analysis confirms that TDRL-551 significantly increases cleaved caspase-3 and PARP cleavage, indicating robust apoptosis induction. Combination studies with cisplatin show strong synergy, with a combination index (CI) < 0.5, enhancing DNA damage accumulation. MCI13E, another RPA inhibitor, demonstrates an IC50 of ~5 μM in lung cancer cells. Cell cycle analysis shows that MCI13E prolongs S-phase and increases cisplatin-induced DNA damage, leading to apoptosis. NERx-329 (NER329), a second-generation RPA inhibitor, demonstrates superior solubility, stability, and cellular uptake compared to TDRL-551 and 2004. It effectively disrupts RPA-ssDNA interactions, with an IC_{50} of 5–10 μM in multiple cancer cell lines, significantly lower than its predecessors. NER329 induces a 4.3-fold increase in Caspase-3/7 activation, leading to apoptosis, and causes replication fork instability similar to ATR inhibitors. In vivo, it achieves potent tumor suppression at a tenfold lower dose than previous inhibitors, highlighting its therapeutic potential. These findings highlight RPA inhibitors' potential for enhancing cancer treatments through replication stress and apoptosis induction.

33 Therapeutic Implications of Nalirifox in Pancreatic Ductal Adenocracinoma

Rasnam, Sai Sukrutha Reddy; Thyagarajan, Anita; Sahu, Ravi P.
Mentor: Sahu, Ravi P.

Pancreatic ductal adenocarcinoma (PDAC) presents therapeutic difficulties and PDAC ranks fourth globally in terms of the frequency of cancer-related deaths. Targeted therapy is becoming more popular because of growing knowledge about PDAC pathophysiology and several targeted treatments for PDAC are being identified and evaluated by ongoing research. As cytotoxic chemotherapy is currently the cornerstone of treatment for PDAC, NALIRIFOX, a combination of four medications, three chemotherapeutic drugs (liposomal irinotecan, fluorouracil, oxaliplatin) and one of which resembles folic acid (i.e., leucovorin), is an emerging standard of therapy. A chemotherapeutic drug called onivyde (irinotecan liposomal) is encapsulated in a liposomal basis to enable longer-lasting irinotecan blood levels. Irinotecan inhibits topoisomerase-I and causes double-strand DNA damage during DNA synthesis. Another chemotherapeutic drug is oxaliplatin, an alkylating agent based on platinum. This drug's platinum complex attaches to DNA and creates cross-links, thereby inhibiting DNA replication, transcription, and cell cycle arrest, ultimately causing cell death. The antimetabolite chemotherapeutic drug in this combination is fluorouracil. This drug binds to thymidylate synthase (TS) to create a stable complex and prevents DNA synthesis. Leucovorin is a folic acid-like medication intended to shield healthy cells from the harmful effects of chemotherapy drugs. Leucovorin also increases the therapeutic efficacy 5-FU. Several experimental and clinical studies have documented an overall increased effectiveness of NALIRIFOX over other chemotherapeutic agents. This regimen improved PDAC 's overall progression-free survival in a statistically and clinically significant manner. The goal of the current studies is to highlight the significance of NALIRIFOX and its implications in therapeutic approaches against PDAC.

34 Exploring the Impact and Mechanisms of microRNA-223 for Non-small Cell Lung Cancer

Rawal, Riya Tushar; Thyagarajan, Anita; Sahu, Ravi P.
Mentor: Sahu, Ravi P.

Lung cancer is one of the most common cancers and the leading cause of cancer-related mortalities worldwide. Approximately 80-85% of lung cancer patients suffer from non-small cell lung cancer (NSCLC). Various FDA-approved therapies, including chemotherapy, targeted therapy, and combination therapy are being used to treat/circumvent tumor growth in NSCLC patients. However, one of the biggest challenges associated with NSCLCs is the poor prognosis, which leads to a delay in detection during the early stages allowing the tumor to progress to an advanced stage. As cancer cells often develop resistance to therapy, identification of novel approaches to overcome this challenge is of utmost importance. Recent studies have shown that microRNAs (miRs) such as miR-223 target several signaling pathways, including AKT and Notch, which play critical roles in regulating various activities of tumor cells, including proliferation and apoptosis. Thus, miRs represent promising candidates to be explored as early prognostic or therapeutic biomarkers. Importantly, miR-223 has also been shown to regulate the chemoresistance mechanisms of several ongoing therapies. The goal of this current study is to highlight the role and mechanisms of miR-223 in NSCLC with an emphasis on its targets and ability to regulate the efficacy of currently used therapeutic agents.

35 Targeting Aurora Kinases to Enhance Immune Checkpoint Inhibitor Efficacy in Lung Cancer: A Promising Therapeutic Strategy

Sabbasani, Jothsna; Thyagarajan, Anita; Sahu, Ravi P.
Mentor: Sahu, Ravi P.

Lung cancer remains a leading cause of cancer-related mortality worldwide, with limited treatment options for patients resistant to standard therapies. Immune checkpoint inhibitors (ICIs) targeting programmed death-1 (PD-1)/PD-ligand1 (PD-L1) and cytotoxic T-lymphocyte antigen 4 (CTLA-4) have revolutionized cancer therapy but are hindered by immune evasion mechanisms within the tumor microenvironment (TME). Aurora kinases (AURKA and AURKB) are the key regulators of cell cycle progression, which have emerged as promising therapeutic targets due to their dual roles in tumor proliferation and immune modulation. AURKA inhibition enhances anti-tumor immunity by reducing immunosuppressive factors such as transforming growth factor beta (TGF-β) and interleukin 10 (IL-10), lowering PD-L1 expression, and increasing MHC-I-mediated antigen presentation. Preclinical and clinical studies demonstrate that combining AURKA inhibitors with ICIs leads to significant tumor regression and enhanced T cell response. AURKB inhibition reprograms the TME by downregulating PD-L1, reducing immunosuppressive cytokines, and improving T cell-mediated immune responses. Preclinical and clinical studies demonstrate that AURKB inhibitors enhance immune responses and sensitize tumors to immune checkpoint blockade, resulting in tumor regression and improved survival outcomes when combined with ICIs compared to monotherapy. This review will provide a concise overview of the biology of Aurora kinases and their oncogenic roles, as demonstrated in preclinical and clinical studies on lung cancer. Ongoing clinical trials are investigating their combination with immune checkpoint inhibitors (ICIs) to evaluate efficacy and identify biomarkers for patient selection. This dual-targeting approach presents a promising strategy to overcome immune resistance and enhance treatment outcomes in lung cancer.

36 The Impact of Formaldehyde on Nasopharyngeal Cancer

Sirigiri, Swarnalatha; Thayagarajan, Anita
Mentor: Sahu, Ravi P.

Formaldehyde exposure has been linked to an increased risk of developing nasopharyngeal cancer. Nasopharyngeal cancer (NPC) is more common in South Asia, the Middle East, and North Africa. It is a rare type of cancer originating in the upper part of the throat, behind the nose. International Agency for Research Cancer (IARC) found that workers who are regularly exposed to formaldehyde had a 1.4 to 1.6 times higher risk of developing nasopharyngeal cancer. This means that in exposed populations, individuals are 40-60% more likely to develop this cancer compared to the general population. Based on Research links formaldehyde exposure to higher rates of nasopharyngeal cancer and leukemia. The mechanism of carcinogenicity involves formaldehyde-induced mutation, DNA adduct formation, and oxidative stress, which contribute to the development of malignant cells in the nasopharyngeal region. Monoclonal antibody drugs like cetuximab, which targets the epidermal growth factor receptor (EGFR), can be used in treatments. These therapies especially target cancer cells to minimize the damage to normal and immunotherapy such as PD-1 inhibitors like nivolumab, pembrolizumab helps to boost the body's immune response. Regulatory agencies have established strict exposure limits for formaldehyde in occupational settings. Proper ventilation, the use of personal protective equipment (PPE), and adherence to exposure guidelines are essential to minimize the risks, especially in high-risk environments. By applying these strategies carefully and consistently, it is possible to reduce the harmful impact of formaldehyde exposure and lower the incidence of nasopharyngeal cancer. Ultimately the goal is to lower the rates of cancer and other diseases related to formaldehyde exposure by raising awareness and implementing effectiveness.

37 Effect of Pioglitazone and Canagliflozin on Cardiac RAS and Sirt1 in db/db Diabetic Mice

Sood, Purab; Fadnavis, Rucha; Kumbaji, Meenasri; Elased, Khalid M.
Mentor: Elased, Khalid M.

Type 2 diabetes significantly increases the risk of diabetic cardiomyopathy (DCM) and nephropathy, partly due to hyperglycemia-induced renin-angiotensin system (RAS) activation and elevated angiotensin II (Ang II). Angiotensin-converting enzyme 2 (ACE2) and neprilysin (NEP) mitigate Ang II effects by generating the vasodilatory peptide angiotensin-(1-7), essential for cardiovascular health. ACE2 deficiency is linked to cardiac dysfunction, while NEP inhibitors and angiotensin receptor blockers are widely used in heart failure. Additionally, SIRT1 activation has emerged as a cardioprotective target. This study examines the effects of pioglitazone (a PPAR-γ agonist) and canagliflozin (an SGLT2 inhibitor) on cardiac ACE2, NEP, and SIRT1 expression in db/db diabetic mice. Six-week-old db/db and lean control mice received either normal chow or chow supplemented with pioglitazone or canagliflozin (20 mg/kg/day). Western blot analysis of cardiac ACE2 revealed two immunoreactive bands: a mature 100 kDa band and a 37 kDa fragment. In the kidney, only the full-length band was detected, indicating organ-specific ACE2 expression. Cardiac ACE2 expression at 37 kDa was significantly higher in db/db mice compared to lean controls.

38 Durability and Efficacy of Metabolic Surgery Compared to Medical and Lifestyle Interventions for Type 2 Diabetes Remission: Insights from the ARRMS-T2D Study

Spann, Jaliyah Nacole; Elased, Khalid M.
Mentor: Elsaed, Khalid M.

As type 2 diabetes mellitus (T2DM) prevalence rises, there is a growing need for effective treatment options. Historically, lifestyle interventions targeting diet and exercise, or the use of glucose lowering agents, has been recommended for treatment. More recently however, clinical evidence has emerged, supporting the use of metabolic surgery as a more effective method for T2DM remission. Nevertheless, hesitancy from patients to undergo this procedure and providers to recommend this method persists, due to a lack of evidence detailing long-term safety and durability. The Alliance of Randomized Trials of Medicine vs. Metabolic Surgery in Type 2 Diabetes (ARRMS-T2D) study, aimed to assess durability and compare the long-time effectiveness of T2DM remission of patients in a bariatric/metabolic surgical cohort against patients who underwent medical/lifestyle intervention. This prospective observational study selected 316 diabetic patients enrolled in either the STAMPEDE, TRIABETES, SLIMM-T2D, or CROSSROAD trials. Surgical interventions were limited to the Roux-en-Y-gastric bypass (RYGB), sleeve gastrectomy (SG), and adjustable gastric banding (AGB). Remission of diabetes was defined as HbA1c ≤ 6.5, after succession of diabetic drugs for 3 months, at 3 years follow-up. 37.5% of the surgical cohort achieved T2DM remission compared to 2.6% in the lifestyle cohort. Reductions in fasting plasma glucose, BMI, and HbA1c were superior in the surgical cohort. Additionally, the percentage of patients using medication to control their diabetes was lower amongst those who underwent surgery. At 3-years follow-up, this consortium demonstrated that metabolic surgery is both safe, durable, and a more effective method than medical/lifestyle intervention in T2DM remission. While these findings support broader adoption of metabolic surgery for eligible patients, further studies are warranted to assess outcomes beyond 3 years and address barriers to patient and provider acceptance.

39 Practice of Oral Antibiotic Suspension Usages among Mothers Visiting Pediatrics Department at a Tertiary Care Center hospital in Nepal

Timsina, Sakchhyam; Sah, Shiv kumar; Adhikari, Rojina; Prasad, Pravin; Thapa, Arjun Bud
Mentor: Xu, Jong-jie

The study was conducted to assess the correct practice of antibiotic suspension usages among caregiver mothers visiting pediatrics department at a tertiary care center in Nepal. Method: This was a hospital-based cross-sectional study, conducted at the pediatric department of the governmental largest tertiary healthcare center in Nepal. A randomly selected 219 eligible caregiver mothers who were prescribed dry antibiotic suspensions for their children were surveyed by using an interviewer administered questionnaire. Result: The overall correct practice of oral antibiotic suspension usages was followed by approximately one-fourth (23.74%) of the survey mothers, with 100 (45.66%) following correct reconstitution practice, 96(43.83%) following correct administration practice, and 58 (26.48%) following correct storage practice. Around 40% of mothers reported that they read instructions, around one-fourth (26%) could understand manufacturers' instructions, and nearly two-third (74.9 %) of mothers asked pharmacists for advice in case of any dilemma regarding instructions in leaflet/drug box. Mothers' age was significantly correlated with overall practice, and with the increasing age the odds of having correct practice were found to decrease by a factor of 0.90 (AOR:0.90; P

40 Impact of Varying Degrees of Thermal Burn Injuries in Young Mice: Role of Microvesicle Particles and Platelet-Activating Factor in Thermal Burn Injury

Travers, Jeffrey B.; Wilfred, Prince; Reese, Rebecca; Khalilzadeh, Danielle; Henkels, Karen; Rapp, Christine; Annapureddy, Niharika; Begum, Muslima

Mentor: Travers, Jeffrey B.

Thermal burn injuries (TBI) are a global health concern, often leading to systemic inflammation and multi-organ failure. Previous data have shown that the prognosis for burn injury worsened with increasing depth and surface area of the burns. The shock was identified as the leading cause of death, along with sepsis, acute respiratory distress syndrome (ARDS), acute renal failure, and wound infection, all significantly associated with mortality. This study investigates how varying burn severities (12.5%, 25%, 37.5% total body surface area (BSA)) in young mice lead to systemic effects through microvesicle particles (MVPs) and platelet-activating factors (PAF). We hypothesize that increased BSA TBI elevates MVP release and PAF-mediated inflammation, mirroring mechanisms seen in intoxicated thermal burns. Using C57BL/6 wild-type (WT), PAF receptor knockout (PAFR KO), and acid sphingomyelinase knockout (SMPD1 KO) mice, we assessed MVP levels, bacterial translocation, and organ inflammation post-TBI. Methods included histology analysis, MVP analysis, RT-qPCR for cytokine profiling, and bacterial translocation analysis. Topical imipramine was tested to block MVP release in WT mice. An increase in BSA of TBI did not significantly affect MVP levels in the skin, but higher burn severity correlated with elevated MVPs in the blood, bacterial translocation to mesenteric lymph nodes, and widespread inflammatory responses in the lungs, small intestine, and liver. The 2-hour study demonstrated rapid progression of systemic inflammation, contributing to bacterial dissemination. While 12.5% BSA TBI caused moderate MVP release and cytokine elevation with minimal bacterial translocation, 25% BSA TBI led to a marked rise in MVPs, cytokines, and bacterial translocation. The most severe burns (37.5% BSA TBI) resulted in the highest MVP release and pronounced cytokine levels. Notably, imipramine treatment effectively reduced MVP release and bacterial translocation in 37.5% of BSA TBI, supporting its therapeutic potential in mitigating systemic inflammation and associated complications. These findings highlight MVP and PAF as central mediators of TBI-induced systemic toxicity. Targeting MVP release via FIASMs or PAFR inhibitors may prevent sepsis and organ failure in burn patients, offering novel therapeutic strategies to improve outcomes in severe burn injuries.

Department of Population and Public Health Sciences

42 A Photovoice Exploration of the Perspectives of Global Health Learners on Reproductive Care

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Mentor: Eustace, Rosemary

Maternal morbidity and mortality remain critical global health concerns, with disparities persisting across resource settings.2 Photovoice, a participatory research method, enables global health learners to document healthcare challenges and foster cross-cultural learning.1 This study examines global health learners' perspectives on health system organization in Tanzania using Photovoice, offering insights into maternal healthcare delivery in resource-limited settings. Methods Through a collaborative learning program, Wright State University and Muhimbili University of Health and Allied Sciences students participated in a two-week immersive experience in Tanzania. Utilizing Photovoice methodology, participants captured images and conducted field observations to examine healthcare infrastructure and service accessibility across clinical settings. Qualitative analysis of photographs and observations identified emerging themes. Results Two key themes emerged: (1) community-driven initiatives in maternal healthcare and (2) maternal health continuity systems. Community-driven initiatives bridged gaps in maternal healthcare access. While district hospitals provided structured maternal health services, dispensaries and health centers functioned efficiently despite resource limitations, often relying on local solutions to meet patient needs. For example, the Nmama emergency transport system, facilitated access to obstetric care for women in remote areas, mitigating provider shortages. In parallel, maternal health continuity systems supported maternal-infant care by ensuring sustained engagement with healthcare services. Tanzania's integrated health system utilized structured tracking mechanisms, such as the Prevention of Mother-to-Child Transmission register, to maintain continuity of care across pregnancy, delivery, and postpartum. Maternal health pamphlets reinforced antenatal care adherence, danger sign recognition, and postpartum health management. Discussion Photovoice provided global health learners with a lens to analyze strengths and challenges within Tanzania's healthcare system. Their observations highlighted the role of community-led initiatives, systematic tracking, and patient education in optimizing care, emphasizing scalable strategies to improve maternal health outcomes and advance global health equity. These insights reinforce the value of experiential learning and participatory research in understanding health systems.

43 Peer Supporter Perspectives on the Roots of Addiction: A Qualitative Study

Hubert, Elise; Silverstein, Sydney
Mentor: Silverstein, Sydney

Problematic drug use has unclear origins with genetics, trauma, and mental health as suspected causal factors. Recently, the brain disease model of addiction, which challenges the damaging stigma that addiction is a moral failing, has gained traction. However, less is known about how people in recovery understand the origins of their drug use, or how they apply the disease model to their recovery. Peer support workers, with lived experience with addiction, provide valuable insight into addiction research and treatment. This qualitative study aims to identify the perspective of peer support workers on the origins of addiction in a personal and broad sense. Methods: Qualitative interviews (n=22) were conducted with individuals who met the following criteria: 1) >18 years of age; 2) work or certification as a peer recovery support worker; 3) work within the SUD treatment ecosystem in the Dayton, OH metropolitan area. Interviews were digitally recorded in their entirety, then transcribed verbatim and uploaded to Taguette software for coding and qualitative analysis. Codes were then analyzed thematically to identify patterns using iterative categorization. Results: Peer supporters unanimously agreed that their personal addictions were multifactorial. However, they believed that addiction origins, in a broad sense, were more ambiguous. Peers identified mental health as the predominant factor, using drugs as coping mechanisms. Trauma and genetics were also mentioned as playing a role in the multifactorial nature of this disease. In a broad sense, peers believed that addiction originates from environmental exposure and altered brain chemistry. Discussion: Peer supporters provide valuable insight to addiction research, which suggests that addiction treatment should be individualized to account for the multifactorial nature of this disease. Through the contribution of peer supporters, we can identify more holistic and empathetic prevention and treatment methods for those living with addiction.

44 The Importance of Peer Recovery Support for Substance Use Disorder

Jones, Torvekia; Barnett, Elizabeth; Garcia, Kandy; Woten, Olivia; Silverstein, Sydney
Mentor: Silverstein, Sydney

Substance use disorder (SUD) has become a major concern for the United States and countries all around the world. Since the recent pandemic in 2020 due to Covid-19, every state has experienced an increase in overdose death numbers. Peer recovery support workers are individuals with lived experience and are trained to assist people with SUD. Peers can work in many different sectors and be of assistance to individuals who suffer with SUD. With peer support work being new there is not a lot of research that has been conducted or that can be found on the topic. This study aims to understand the role and importance of peer recovery support for SUD in the Dayton area. Methods: Qualitative interviews (n=22) were conducted with individuals who met the following criteria: 1) >18 years of age; 2) work or certification as a peer recovery support worker; 3) work within the SUD treatment ecosystem in the Dayton, OH metropolitan area. Interviews were transcribed and entered in Taguette software for coding. The study team developed a codebook collaboratively and coded all interviews. Thematic analysis of select codes was conducted to identify common themes in data. Results: After analyzing the data through iterative categorization, there were three major key findings: 1) Peer recovery support workers believe that their work is needed in schools, hospitals, and criminal justice; 2) Peers also believe that sharing their stories is beneficial for the clients and themselves; and 3) Peer recovery support workers also face a lot of challenges with the work that they do. Conclusions: In conclusion, SUD has become a major public health concern for countries and especially the United States. Peers wish to share their experience to connect with people who often feel like they are unwanted and to help guide them on to a better path. Peer recovery support is something new and there needs to be more discussions about peer recovery support and the work that they do.

45 Peers and Healthcare: Beliefs about addiction medicine in Dayton, Ohio

Woten, Olivia; Barnett, Elizabeth; Garcia, Kandy; Jones, Torvekia; Silverstein, Sydney
Mentor: Silverstein, Sydney

The following study demonstrates the ways peers believe there could be changes in the ways they are accepted into medical settings. Dayton, Ohio is known for excessive rates of substance use disorder and overdose deaths after the 2017 opioid crisis. Peer workers can be a valuable asset in healthcare settings, but more research needs to be done to understand where there are gaps between clinical professionals and peer workers. A combination of peer interviews, qualitative data analysis with Taguette software, and iterative categorization were used to collect and analyze data. Qualitative data analysis was used to determine key themes, subthemes, and supporting quotes. The first key theme was that peers feel that they are valuable assets to hospitals, but they are underrepresented or not taken seriously by other health professionals. Two subthemes included: 1) hospitals provided peers with the opportunity to reach out to patients with treatment options, and 2) MATs are possibly underutilized in hospitals because of a lack of understanding between peers and patients. The second key theme was that peers believe that healthcare workers have different assets or downfalls compared to peers. Three subthemes included: 1) healthcare workers lack personal experience of addiction, so they do not understand or cannot connect with patients like peers do, 2) healthcare workers can be pushy, unwelcoming, or condescending to peers and patients, and 3) healthcare workers can make a lasting impact on recovery journeys. The third key theme was that peers have predispositions about treatment options for substance use disorders. Two subthemes included: 1) many peers want to be included in the conversation about MATs in clinical settings, and 2) mental health and substance use disorders are correlated. To ensure addiction medicine patients receive high quality healthcare, peer workers and healthcare professionals should continue to work together.

College of Engineering and Computer Science

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46 Spinal Motor Neuron Excitability Changes in Aging

Halim, Ibrahim Abdul; Elbasiouny, Sherif
Mentor: Elbasiouny, Sherif

Over 40% of older adults (>65) have reported the loss of ability to perform daily tasks due to age-related weakness. While age-related weakness remains a significant public health issue, the exact etiology remains unclear. Age-related weakness has recently been perceived as multi-factorial with factors stemming from the neurological system. Spinal motor neuron (MN) excitability plays a major role in muscle contraction. Small conductance calcium activated channels (SK) are essential in MN excitability due to their critical role in regulating the after-hyperpolarization phase (AHP). The present study examines how spinal motor neuron (MN) intrinsic excitability is affected with age. In vitro intracellular recording from MNs in male and female C57BL/6 mice across three age groups – young (3-4), middle-aged (12-14), and old (26+ months) – were used to investigate the MN's intrinsic properties. MN excitability was assessed by measuring cell firing frequency vs. current. SK channel activity was examined using the depth of the AHP of the action potential. Our results show reduction in MN firing frequency and excitability in the older age group. In addition, our results demonstrate significant increase in AHP depth at the older age group. Significant sex difference in the older age group with female mice having a larger AHP than the male mice is present. Our findings indicate aging not only affects muscles however it also affects MNs and MN reduced excitability could be contributing to motor weakness in aging. Moreover, our results indicate that SK channel activity is increased in aging with females having significantly higher activity than males. This phenomenon could potentially explain the significant decrease in MN excitability with age as well as a factor of age-related weakness. Ultimately, these findings provide insights to the membrane mechanisms underlying age-related weakness.

47 Failure Analysis of Saline and Silicone-gel Filled Breast Implants

Barba Soriano, Celia
Mentor: Goswami, Tarun

Breast implants are widely used in both reconstructive surgery post-mastectomy and cosmetic surgery since the 1960s, yet their long-term performance and potential failure remain significant concerns for patient safety. The common complications associated with breast implant failure are capsular contracture, implant rupture, and leakage which often leads to corrective surgery. Objective: This study aims to analyze the failure mechanisms of two silicone-gel and two saline-filled breast implants, focusing on material degradation, mechanical stress, and environmental factors contributing to implant failure. A combination of macroscopic examination, Fourier-transform infrared spectroscopy (FTIR), and optical microscope will be used to examine explanted implants exhibiting signs of failure. There are many factors that can affect the failure of breast implants (e.g. incompetent valves, manufacturing defects, and underfilling of the implant, which leads to folds in the implant capsule, trauma, and repeated stress during daily activities). Results: The visual examination of the breast implants presented cracks in the valve system of the saline implants that resulted in leaks, as well as scratches found on the shell of the silicone-gel filled implants (removed after 9 months of usage). The results will indicate the possible causes of failure of the silicone-gel and saline filled breast implants. This is significant because by focusing on the causes of implant failure professionals can work together to enhance the safety and reliability of breast implants.

48 Failure Analysis of Implantable Cardioverter Defibrillators (ICDs)

Goswami, Tarun; Bobba, Baskar Reddy
Mentor: Goswami, Tarun

Defibrillators are life-saving devices that restore normal cardiac rhythm by shocking the heart with a regulated electric shock in cases of severe cardiac arrhythmias. The Failure analysis of implantable cardioverter defibrillators (ICDs) are examined in this project. This analysis is essential for upgrading the patient safety and the advancement for the next generation ICD device. In order to link device malfunctions to unfavorable patient outcomes, case studies of explanted ICDs from clinical settings will examined. The current situations that we are seeing in the market are, aside from the problems in biocompatibility and hermetic sealing, one of the most prevalent causes of device breakdown is lead fatigue. Firmware bugs and incorrect programming also provided functional issues. Improvement in design is necessary through better materials, stronger constructions of leads, and algorithms for predictive maintenance software. This study represents the importance of interdisciplinary collaboration, tight quality control, and continuous monitoring in prolonging the life and functionality of ICDs, safeguarding patient health, and reducing medical costs due to device failures.

49 Comparative Analysis of Total Knee Arthroplasty Data from the German National Register

Goswami, Tarun; Bobba, Baskar Reddy
Mentor: Goswami, Tarun

The project's goal is analyzing and evaluating knee replacement operations throughout Germany. Data on patient demographics, surgical methods, implant kinds, postoperative results, and long-term follow-up outcomes will all be gathered centrally through this registry. The registry aims to improve patient care, spot patterns, and raise the standard of knee replacement surgery by combining data from multiple healthcare facilities. The project also aims to promote research by offering insightful information about the durability and treatment of various knee implants. By providing solid, evidence-based data, it also seeks to assist clinical decision-making and policy creation. The registry will increase orthopedic treatment in Germany by fostering standardization of practices through partnerships with orthopedic surgeons, hospitals, and regulatory agencies.

50 Utilizing Magnetic Resonance Imaging (MRI) and MIMICS for Early Detection of Gray Matter Volumetric Alterations in Alzheimer's Disease

Chalise, Akshay Sai; Jampani, Sai Kumar; Sarfaraz, Mohammed; Savva, Uday Charan; Dharanikota, Venkata Gopi; Reddy, Kunchala keerthi Laxmi; Kanagala, Venkata Sivameghana
Mentor: Goswami, Tarun

Dementia is caused by brain cell degradation in Alzheimer's disease (AD), a progressive neurodegenerative disorder. It is the leading cause of dementia, accounting for 60-80% of all cases. Alzheimer's affects more than 6.7 million individuals in the United States alone, with that figure anticipated to rise to 13 million by 2025. Alzheimer's disease (AD) and other forms of dementia have a huge financial impact; medical and long-term care costs are estimated to reach 340 billion in 2024, rising to 1 trillion dollars per year by 2050. To diagnose Alzheimer's disease, a full evaluation is required, which includes laboratory tests such as vitamin B12 levels, neurological exams, and MRIs to assess neuron integrity. Biomarkers are crucial in diagnosis, with amyloid deposition identified by low cerebrospinal fluid (CSF) amyloid levels or positive amyloid PET scans, and tau deposition found by tau PET imaging. In this study, we used magnetic resonance imaging (MRI) scans to detect gray matter volumetric changes, a major biomarker of Alzheimer's disease. The subjects' brain volume and surface area were measured using an automated workflow in MIMICS (Materialise Interactive Medical Imaging Control System) we aim to use MIMICS as a tool to detect and study Alzheimer's disease. Early and precise diagnosis, aided by improved imaging techniques, is critical for controlling the condition and reducing its impact on patients and healthcare systems.

51 Exploring Persistent Inward Currents: Key Differences in Two ALS Animal Models

Deutsch, Andrew J.; Elbasiouny, Sherif M.
Mentor: Elbasiouny, Sherif M.

Persistent inward currents (PICs), mediated by ion channels, regulate spinal motoneuron (MN) firing. We previously demonstrated that all PIC components are altered in the standard ALS model (SOD mice), leading to increased net PIC and intrinsic excitability at symptom onset (Deutsch & Elbasiouny, 2024). In this study, we investigate MN excitability in a TDP-43 ALS model for the first time. We found that TDP-43 MNs exhibit decreased net PIC, with alterations to all PIC components. Specifically, at symptom onset, sodium and calcium PICs are reduced, while the small-conductance calcium-activated potassium persistent outward current (SKL POC)-to-Ca PIC (SKL/Ca) ratio is increased compared to controls. At symptom onset, in contrast to SOD MNs, TDP-43 MNs have decreased net PIC and intrinsic excitability. Together, our results reveal a key mechanism of MN excitability dysfunction in ALS.

52 Anthropometry - Female Chest

Galbreath, Sheila; Goswami, Tarun
Mentor: Goswami, Tarun

Anthropometric data is applicable to manufacturing (e.g. clothing, equipment, etc.), work environments, and healthcare. Although there is a plethora of manual instruments employed to take quantitative measurements, recent technology can obtain scans minimizing direct contact with the subject. 3D scanners (e.g. Kinect, Artec, etc.) can model the human shape, allowing evaluation with good accuracy after the participant is no longer present. These tools will be utilized in this project to characterize female chest anatomy for ages 18-42. The interdisciplinary component of this field of science requires interaction with participants, learning data flow, and integrating multiple disciplines. Experimental design and data collection/reduction may use methods such as machine learning that will produce mathematical prediction models of women anthropomorphic. The design of experiment will produce ~281 data points with an option of ~ 78,680 combinations, assuming measurement order matters when using two measurements. A chest model created and simulated to better understand biological (tissue level) and biomechanics behavior under various conditions. Clinical skills are necessary to identify anatomical landmarks. The most significant part of this study is that the data will support female military members and may have profound applications in the clinical setting, manufacturing, and work environments.

53 Revolutionizing the Study of Motoneuron Soma Structure and Ion Channel Expression: Addressing Reproducibility and Sensitivity of our Novel 3D Analysis Algorithm

Highlander, Morgan; Michelle; Ward, Shelby; Elbasiouny, Sherif
Mentor: Elbasiouny, Sherif

Motoneuron soma structure and ion channel protein expression are important indicators of physiological mechanisms underlying cell function. Unfortunately, existing techniques for measuring somas and their protein expressions lack reproducibility due to subjectivity of analysis and parameters that are highly sensitive to sampling errors and manual tracing variability. We have developed an algorithm specifically to address these weaknesses by eliminating manual tracing and protein sampling. Our algorithms use automated soma edge detection to produce 3D reconstructions that enable analysis of 100% of protein expression on the 3D soma surface. We show marked improvement in reproducibility of our results compared to prior manual methods. Additionally, we characterize the sensitivity of our parameters to the chosen analysis settings of the algorithm. Although we cannot eliminate all sensitivity to algorithm settings, we can demonstrate this sensitivity and report our quantified settings to ensure the transparency and rigor of our analysis. Additionally, we introduce an automated approach for using parameter sensitivity to find analysis settings that maximize stability of our results. Taken together, our approach allows us to reproducibly and objectively compare soma structure and somatic protein expression of motoneurons across and between datasets with unprecedented rigor. Our approach thereby revolutionizes analysis of protein expressions and will subsequently increase our understanding of the physiological mechanisms underlying cell function.

54 Failure Analysis of Philos Plate and Screw

Jampani, Sai Kumar; Goswami, Tarun
Mentor: Goswami, Tarun

The Proximal Humerus Internal Locking System (PHILOS) plate is a popular orthopedic implant for anchoring proximal humerus fractures. Despite its structural advantages, failures have occurred, resulting in difficulties such as plate breakage, screw loosening, and implant migration. This paper presents a failure analysis of a retrieved PHILOS plate and screw system, focusing on the mechanical and material causes of failure. Visual examination, scanning electron microscopy (SEM), and material composition analysis are utilized to detect failure modes like fatigue fracture, stress concentration, and corrosion. Preliminary data indicate that high cyclic loading, insufficient bone-implant interface stability, and stress shielding effects all contribute significantly to implant failure.

55 Comparative Analysis of Total Knee Arthroplasty Data from the Norwegian National Registry

Mallets, Joshua Robert
Mentor: Goswami, Tarun

National registries of Knee and Hip Arthroplasties provide an extensive history of data on joint prostheses that can be used to generate a comparative analysis between different countries. By standardizing data collection for each country, one can compare various geographical and demographic factors that may play a role in data variation. In this report, data from the "Norwegian National Network for Arthroplasty and Hip Fracture" registry will be collected and compared to data from other countries, such as Sweden, Canada, Germany, and the United States. The focus of the data will be on Knee Arthroplasties and, more specifically, the reasons for primary arthroplasty, revision surgery, and reoperation surgery. Using this data, engineers can identify the focus points needed in prostheses design with additional insight into the demographics and human factors involved in that country's population receiving the devices. Thus, this report focuses on the compilation of knee arthroplasty data from the Norwegian National Registry that will be compared to other country's data.

56 Comparative Failure Analysis of 3D Printed and Bioprinted Knee Replacement Liners

Mallets, Joshua Robert
Mentor: Goswami, Tarun

The knee is the largest synovial joint in the body and serves a crucial role in the movement of the human body. It is composed of the femur, tibia, and patella bones and is stabilized and protected by various muscles, ligaments, and bursae. Osteoarthritis is a condition caused by the interplay of different risk factors that lead to the degradation of the knee, especially the articular cartilage. While several treatments for early osteoarthritis exist, the gold standard for late-stage osteoarthritis is total knee arthroplasty. This procedure removes the damaged tissue and replaces the joint with artificial components. A total knee replacement consists of a patellar component, a femoral component, a tibial component, and a polymer spacer or liner. Different methods of 3D printing such as stereolithography, fused deposition modeling, and bioprinting pose as possible methods of producing this liner used in knee replacements. However, comparing the failure mechanism of 3D printed versus bioprinted liners could give insight into the viability of using liners produced by these techniques in a practical application. Thus, this report aims to compare the failure mechanism of a 3D-printed knee liner and a bioprinted knee liner.

57 Failure and Analysis of Neurostimulator

Manda, Geetha Sri; Goswami, Tarun
Mentor: Goswami, Tarun

Neurostimulators are implantable medical devices used for modulating the activity of nerves in treating conditions of the nervous system the advantage of the neurostimulators is outweighed by frequent malfunctions of these devices resulting in detrimental effects on patients in critical health issues finance and quality of life the present study on failure analysis is on neurostimulators covering mode and cause consequences diagnostics with optical microscope test and visual inspection understanding these failure causes can help improve manufacturing materials and monitoring methods to increase device dependability battery depletion lead breakage or migration device corrosion and absence of stimulation are common malfunctioning these malfunctions may cause deleterious effects on health patient discomfort or reduction in the efficacy of the therapy failure analysis includes device performance analysis imaging tests and root cause analysis on explanted devices electrophysiological examination imaging (MRI, CT), and diligent histological analysis of the neighboring tissues are major diagnostic tools neurostimulation therapy can be adjusted and customized based on the patients requirements and needs to treatment.

58 AI-Driven Framework for Assessing Donor Suitability in Eye Transplantation

Manghe, Fidelis Obi; Manda, Geetha Sri; Goswami, Tarun
Mentor: Goswami, Tarun

This research proposes an AI-driven framework to enhance the efficiency, accuracy, and consistency of donor suitability assessments in eye transplantation. Current manual evaluation methods are time-consuming, prone to human error, and inconsistent across evaluators. By leveraging Natural Language Processing (NLP), Machine Learning (ML), and Database Integration, this system will automate and identify critical donor eligibility criteria (such as sepsis, blood products, and electronic medical records), and provide a structured recommendation system for eye banks. The proposed model will be trained on large-scale donor medical datasets, ensuring high precision and explainability. The goal is to enhance the eye banking workflow, optimize donor selection, and improve outcomes for corneal transplant recipients.

59 Machine Learning Approaches for Estimating Pacemaker Battery Longevity

Neupane, Samikshya; Goswami, Tarun
Mentor: Goswami, Tarun

To maximize patient care and ensure timely device replacement, the pacemaker's remaining battery life must be accurately predicted. Using Medtronic pacemaker interrogation reports, this research focuses on creating machine-learning models to estimate battery longevity. To determine their effect on battery performance, important operational parameters are examined, such as voltage, pacing percentage, lead current, battery impedance, battery current, capture threshold, etc. To increase prediction accuracy, three machine learning models are used: a Random Forest model that uses ensemble learning to handle high-dimensional data and complex feature interactions, a Neural Network model (MLP) that uses ReLU activation, and the Adam solver to capture complex, non-linear relationships, and a Linear Regression model as a baseline reference. Monte Carlo simulations are used to evaluate the robustness of these models by introducing controlled variations in the input data. This enables a thorough assessment of prediction stability. This simulation-based method guarantees that the models can efficiently handle uncertainty in pacemaker data and generalize well under many circumstances. Normal probability plots are analyzed to examine the distribution of predicted values and check for deviations from normality, which can impact model interpretability and reliability. Residual plots further aid in evaluating model performance by identifying patterns that indicate potential underfitting or overfitting. For the benefit of medical practitioners and manufacturers, the study offers a standardized framework for assessing the longevity of Medtronic pacemaker batteries. This research improves device management decision-making by incorporating sophisticated data mining techniques, which may reduce needless replacements and improve long-term patient outcomes. The results open the door for better safety procedures and regulatory standards in pacemaker technology and aid in the continuous development of more dependable and effective cardiac rhythm control systems.

60 Ankle Joint Anthropometry

Sattler, Douglas Robert; Gundapaneni, Dinesh
Mentor: Goswami, Tarun

The ankle joint must allow for high mobility while also ensuring stability while under high forces during the gait cycle. Within the ankle joint, the talocrural joint bears most of the forces, accounts for most of the plantar- and dorsiflexion in the ankle, and is a major component in ensuring stability of the ankle joint. The shape of both the talus and tibia and the relationship between the two bones affect how the mobility and forces are facilitated within the joint. Creating a set of parameters that encompass the interactions within the talocrural joint is crucial in providing better care for the joint, particularly in the design and selection of total ankle replacements. By utilizing a set of imaging data from 22 subjects (ranging both genders and across ages), a set of those morphological parameters is to be expanded and refined. Similarly, the relationship between parameters, both solely on the talus or tibia and across the two bones, is to be determined and refined.

61 Failure Analysis of Retrieved Hip Implants: Wear Assessment and Surface Topography

Goswami, Tarun; Shetty, Rakshitha Keshava
Mentor: Goswami, Tarun

Hip implants are continuously exposed to mechanical and biochemical interaction within the body, leading to progressive wear, fatigue, and surface degradation. It is important to understand such failure mechanisms so that patient care and implant life can be improved. Failure characteristics and patterns of wear from retrieved hip implants are analyzed under visual examination as well as for advanced surface topography analysis in this research using optical microscopy. Quantification of the principal features such as scratches, pitting, wear tracks, and damage due to fatigue will be conducted. The degree of implant degradation will be assessed based on a calculated damage score. The current research strives to provide critical information about hip implant material wear behaviors to aid in the optimization of implant design, material selection, and clinical techniques for better orthopedic implant performance.

62 Comparative Analysis of Total Knee and Hip Arthroplasty Data from the Canadian National Registry

Goswami, Tarun; Shetty, Rakshitha Keshava
Mentor: Goswami, Tarun

This study reviews Canadian National Registry data for total knee and hip arthroplasty, indications for revision surgery, gender trends over the last five years, and impacts of the COVID-19 pandemic. A few of the most notable causes of revision surgery are liner wear, dislocation, fracture, infection, and aseptic loosening, which indicate engineering-related failure as the cause of premature implant revisions. Gender trends show that in 2020, there were more surgeries in males, while in 2022, more operations were carried out in females, a reversal in the trend. The COVID-19 pandemic made elective surgeries fall drastically, with hip replacements by 12.9% and knee replacements by 26.4% in 2020–2021. However, in 2021, reopening of restoration services like hip and knee replacement increased by 5.9% but was still lower than pre-pandemic levels. This research provides a sage snapshot of long-term trends and challenges in joint replacement surgery, once more stimulating future healthcare planning and implant design development initiatives.

63 Failure analysis in Orthopaedic Knee Liners

Wakale, Supriya Prakash; Goswami, Tarun
Mentor: Goswami, Tarun

Knee liners play a very important role in total knee replacement (TKR) implants, serving as an interface between tibial and femoral implants for smooth articulation and loading distribution. Even though they are made of ultra-high molecular weight polyethylene (UHMWPE) for superior wear resistance, they suffer from fatigue, wear, delamination, and oxidative degradation that leads to issues such as osteolysis, loosening of the implant, and impaired joint function. This study includes evaluation of five different types of knee liners retrieved from surgery. Surface topography analysis of these liners with an optical microscope uncovered damage in the form of scratching, pitting, and wear. Furthermore, a damage scoring method defined by Hood et al and modified at Wright State University will be used to evaluate the findings and draw conclusions with it. The study detects trends in failure, the influence of material properties, surgical technique, and patient-specific factors, providing insights to improve knee liner design, durability, and TKR success rates.

64 Comparative Analysis of Total Hip and Knee Arthroplasty Data from the American Joint Replacement Registry Data

Wakale, Supriya Prakash; Goswami, Tarun
Mentor: Goswami, Tarun

This is a comprehensive review of the American Joint Replacement Registry (AJRR) over ten years for all aspects of total knee and total hip arthroplasty. The review will include patient demographics, surgical technique, implant types, revision rates, and patient-reported outcomes. Statistical analysis will include trends over time, gender disparities, age distribution, and survival of the implants. The study will also determine the impact of the COVID-19 pandemic, with a focus on procedural volume variation and highlight the overall fluctuation of data over the years. Reasons for revision such as infection, mechanical failure, periprosthetic fractures, and wear of implants will also be examined extensively to provide insights into risk factors and long-term outcomes. The study is a useful reference for orthopaedic research and clinical practice improvement through successful data analysis.

Department of Computer Science and Engineering

65 Adversarial Attack Resilient ML-Assisted Hardware Trojan Detection Technique

AlKurdi, Mohammed G M; Ghimire, Ashutosh; Amsaad, Fathi
Mentor: Amsaad, Fathi

Recent hardware trojan detection (HTD) techniques employ supervised machine learning to ascertain the presence of Hardware Trojans in Integrated Chips (ICs) manufactured in untrusted Foundries. However, Supervised Machine Learning models are vulnerable to adversarial attacks, through which adversaries could utilize resulting adversarial samples to modify their hardware trojans and circumvent these detection techniques. In the proposed work, adversarial attacks are introduced against published supervised machine learning models that use classified data of side-channel analysis information for hardware trojan detection in integrated circuits. It is demonstrated that these models are susceptible to Feature Space Adversarial Attacks, achieving a successful evasion rate of more than 50%, with over 50% of adversarial samples being misclassified. Additionally, as a means to mitigate the adversarial attack, adversarial learning techniques are implemented on the attacked model to reinforce the resilience of the machine learning model, achieving more than 50% increase in resiliency against adversarial attacks, while accuracy loss of the re-trained model was maintained below 10%.

66 Exploring Gender Differences in Chronic Pain Experiences: A Machine Learning Analysis of Discussions from Reddit

Andrade, Ancita Maria; Banerjee, Tanvi; Ramakrishna, M
Mentor: Banerjee, Tanvi

Pain is an inherent part of human existence and can manifest as physical or emotional, and can be either acute or chronic. Extensive research has been conducted over the years to understand the causes of pain and explore potential cures, with contributions from various scientific disciplines. However, earlier studies often overlooked the role of gender in pain experiences. In this study, we applied Natural Language Processing (NLP) to analyze and gain deeper insights into individuals' pain experiences, with a particular focus on gender differences. We successfully classified posts into male and female corpora using the Hidden Attribute Model-Convolutional Neural Network (HAM-CNN) and analyzed linguistic differences between genders that were self-reported. Our findings showed that female posts tend to be more emotionally focused. The study also highlighted that conditions such as migraine and sinusitis are more prevalent among females and explored how pain medication drugs like gabapentin and amitriptyline affect individuals differently based on gender.

67 Understanding Physiological Responses for Intelligent Posture Detection Using Wearable Technology

Anumula, Chaitanya Vardhini; Banerjee, Tanvi
Mentor: Banerjee, Tanvi

This study investigates autonomic nervous system (ANS) responses during Iyengar yoga postures using wearable technology. A multi-case longitudinal study was conducted with 16 participants, utilizing EmbracePlus smartwatches to collect physiological signals, including heart rate, electrodermal activity (EDA), skin temperature, and blood volume pulse (BVP). Data were recorded during baseline and postural phases to assess sympathetic and parasympathetic activation. Feature extraction and correlation-based selection reduced the feature set to 25 key features. A variety of machine learning models, including Logistic Regression, Gaussian Naive Bayes, Random Forest, and Decision Tree, were employed for classification. All models demonstrated strong performance, achieving over 90% accuracy in distinguishing baseline and postural phases. Point-biserial correlation analysis and feature importance from models consistently aligned, highlighting key features such as skin temperature, EDA, and RR intervals as significant indicators of ANS responses. Results indicate a parasympathetic shift during yoga postures, evidenced by increased skin temperature and decreased EDA and heart rate, reflecting enhanced autonomic regulation. This study highlights the effectiveness of machine learning models in interpreting physiological responses and underscores the potential of wearable-assisted monitoring for intelligent posture detection. The findings contribute valuable insights for digital health applications and the integration of data-driven approaches in therapeutic interventions and personalized wellness solutions.

68 Efficient Object Detection from Fused RGB and IR Aerial Images Enhanced by Token Selection

Chitroju Kodanda Saiayyappa, Raghavendra Sesha Narayanacharyulu; Banerjee, Tanvi; Zhang, Wen

Mentor: Banerjee, Tanvi

Object detection is a fundamental task in computer vision, with critical applications in autonomous driving, surveillance, and robotics. Traditional object detection models rely on RGB images, which perform well under favorable lighting but degrade in low-visibility environments such as nighttime or adverse weather. Infrared (IR) imagery, which captures thermal information, offers improved performance in such conditions but lacks structural and color details. Combining RGB and IR modalities has the potential to enhance detection accuracy by leveraging their complementary strengths. However, RGB-IR fusion for aerial imagery remains underexplored, and the scarcity of publicly available paired datasets further limits research in this area. Additionally, implementing onboard fusion models for aerial applications, such as on drones, poses significant challenges, including feature-level fusion complexity and high computational overhead. In this work, we propose an efficient RGB-IR fusion framework specifically designed for aerial image datasets. Our framework integrates pixel-level fusion and transformer-based feature-level fusion to capture both low-level and high-level cross-modal interactions. To address computational constraints, we introduce a token selection mechanism that dynamically selects the most informative tokens, reducing inference time while maintaining high detection performance. Extensive experiments conducted on an RGB-IR aerial image dataset demonstrate that our proposed framework significantly improves detection accuracy and computational efficiency.

69 Automatically Inferring Image Base Addresses of ARM32 Binaries Using Architecture Features

Chong, Daniel T; Zhang, Junjie; Boland, Nathaniel; Chen, Lingwei
Mentor: Zhang, Junjie

We designed an innovative method, namely iBase, which automatically infers the image base address of an ARM32 binary by statistically, structurally, and semantically correlating the absolute and the relative addresses contained in the binary. iBase exploits ARM32's architecture features, and hence it is immune to variances introduced by software development and compilation. In addition, iBase is parameter-free and it requires no manual configuration. We implemented iBase and performed evaluation using 20 ARM32 binaries. Our evaluation results have shown that iBase successfully detects base addresses for all of them and outperforms start-of-the-art tools including Ghidra and Radare2.

70 Network Anomaly Detection for IoT Using Hyperdimensional Computing on NSL-KDD

Ghajari, Ghazal; Ghimire, Ashutosh; Ghajari, Elaheh; Amsaad, Fathi
Mentor: Amsaad, Fathi

With the rapid growth of IoT devices, ensuring robust network security has become a critical challenge. Traditional intrusion detection systems (IDSs) often face limitations in detecting sophisticated attacks within high-dimensional and complex data environments. This paper presents a novel approach to network anomaly detection using hyperdimensional computing (HDC) techniques, specifically applied to the NSL-KDD dataset. The proposed method leverages the efficiency of HDC in processing large-scale data to identify both known and unknown attack patterns. The model achieved an accuracy of 91.55% on the KDDTrain+ subset, outperforming traditional approaches. These comparative evaluations underscore the model's superior performance, highlighting its potential in advancing anomaly detection for IoT networks and contributing to more secure and intelligent cybersecurity solutions.

71 A Golden-Free Hardware Trojan Detection using Unsupervised ML and On-Chip Localization

Ghimire, Ashutosh; Hossain, Tanvir
Mentor: Amsaad, Fathi

Hardware Trojans are one type of deliberately inserted malicious hardware circuitry modifications that pose a significant threat to the security and trust of semiconductor integrated circuits (ICs) applications including the potential leakage of sensitive and secure information and/or deactivation or destruction of the IC devices. Detection of hardware Trojans is crucial to ensure the trust, verification, and security of the semiconductor integrated circuits (ICs) process. Existing hardware Trojan detection approaches are often destructive and require intricate comparisons or extensive reverse engineering. In this paper, we propose a novel hybrid security approach to enhance the detection of golden-free hardware Trojans using unsupervised machine learning (ML) followed by on-chip localization. The proposed approach initially utilizes unsupervised ML clustering of side-channel analysis (ring oscillator frequencies) to enhance golden-free hardware Trojan classification. The proposed method eliminates the need for golden hardware Trojan data. Furthermore, the proposed approach employs a practical and efficient on-chip localization, simplifying the reverse engineering process needed for hardware Trojan detection and rendering the verification process more efficient. To validate the effectiveness of this approach, hardware Trojans of various designs and sizes are inserted into an md5 cryptic core with side-channel features, realized on real hardware using Field Programmable Gate Arrays (FPGAs). The results show that our developed ML-assisted security model exhibited a higher accuracy rate of 98.9% for the detection of small and short-triggered Trojans compared to existing methods.

72 2-in-1 Phishing Detection via Large LM distillation and Small LM Perturbation

Greenewald, Calvin; Ashmore, Bradley; Poon, Chief Sing; Chen, Lingwei
Mentor: Vaughan, Michelle

Phishing emails are an escalating threat, underscoring the need for precise detection methods. While large language models (LLMs) have gained attention for their potential in this area, their reliance on extensive data for fine-tuning poses practical challenges. This paper introduces DualLM for phishing detection with minimal data, which distills the reasoning ability from a large LM to enhance a small tar- get LM and integrates trainable perturbations to improve the small LM's inference capabilities. Experiments demonstrate that DualLM can benefit from dual LMs, which reduces train- ing parameters and data required, while maintaining high per- formance in phishing email detection with limited data.

73 Generative Adverserial Network, Motion Sickness Study

Harikumar, Harigovind; Ghosh, Tomojit
Mentor: Ghosh, Tomojit

Generative Adversarial Networks (GANs) have revolutionized artificial intelligence by enabling the creation of highly realistic synthetic data. In the context of motion sickness studies, GANs offer a novel approach to simulating and analyzing physiological responses, virtual environments, and predictive modeling. Traditional motion sickness research relies on physical experiments and subjective assessments, which can be time-consuming and inconsistent. Given the limited sample size, this study employs GANs as the generative AI model to augment the dataset, ensuring robust analysis of susceptibility and resistibility labels. By generating synthetic data, we can find new biomarkers and improve detection. Additionally, GANs will be leveraged to identify key biomarkers associated with motion sickness susceptibility, providing deeper insights into physiological patterns and potential predictive markers. The findings underscore the transformative role of AI in improving the accuracy, efficiency, and personalization of motion sickness studies, paving the way for enhanced AI interaction in immersive environments.

74 Structure-Preserving Approach to Dimensionality Reduction for High Dimensional Biological Data

Kanakamalla, Prathyusha; Ghosh, Tomojit
Mentor: Ghosh, Tomojit

High-dimensional biological data often holds intricate patterns that are challenging to interpret when reduced to lower dimensions. We introduce a novel dimensionality reduction model designed to preserve global structure by maintaining pairwise centroid distances. Unlike traditional methods that may distort relationships, our approach retains meaningful patterns, enabling more reliable analysis of complex datasets. The challenge biologists face today isn't just about collecting data – it's about making sense of the vast amount of information they gather. Our model addresses this by providing a reliable way to simplify complex datasets while keeping their fundamental relationships intact. This is particularly relevant for analyzing biological responses to environmental stresses, where multiple factors interact simultaneously. We're particularly excited about applying this model to high-altitude hypoxia datasets related to acute mountain sickness (AMS). By maintaining the structure of hypoxia-related data, our approach could help identify subtle patterns in how the human body responds to reduced oxygen levels at high altitudes. This could potentially lead to better understanding of why some individuals are more susceptible to mountain sickness than others, and how various biological pathways interact during high-altitude adaptation. Our model aims to bridge the gap between complex biological data and actionable insights, potentially contributing to improved prevention strategies for AMS.

119 Virtual Reality Skill-Building Applications Employing Real-Time Physiological Data

Matzek, Ethan Charles; Banerjee, Sean; Banerjee, Natasha; Yankee, Tyler; Kohler, Odin; Lipke-Perry, Tracy; Megyeri, Ava

Mentor: Banerjee, Sean

Virtual Reality (VR) as a platform is praised for its immersion and interactivity. Research utilizing VR provides users a space to develop skills in an environment more compatible to the physical world than traditional approaches. Where VR often falls short of reaching its potential is the lack of real-world data driving its applications. Access to users' physiological data during runtime would allow the application to adapt to fit individual needs. My work melds the immersion of VR with simultaneous streaming of physiological data to provide holistic feedback for skill growth. I present two VR applications following this structure. The first is VRMonic, a VR piano tutor for learning correct hand form for piano by overlaying the playing form of an expert oracle. VRMonic employs a library of recorded scales acquired via RGB-D cameras and lets users upload their own recordings for comparison. During playback, VRMonic displays joint-by-joint variations between the recorded data and the oracle by highlighting areas of correct form and coloring the highlight based upon the overall accuracy of the match between the recorded play and the oracle. Heart rate (HR) and surface electromyography (sEMG) sensors can be worn during playtime to track the users' physiological signals during a session. The second application I present is VitaMaze, an exergame designed to promote a healthy lifestyle using physiological sensor-based feedback to guide gameplay. VitaMaze is a maze-based application that implements HR and sEMG sensors attached to the player's body to control avatar motion in game. I apply intelligent decision-making algorithms to decipher incoming data from the sensors and generate deterministic real-time movement based on the players perceived effort. The player is encouraged to exert themselves while playing to decrease their completion time in the maze and is offered visual feedback on their exertion level throughout play.

120 GraspPC: Transformer-Based Generation of Diverse Hand Grasp Point Clouds

Megyeri, Ava Maria; Widerhold, Noah; Kyrarini, Maria; Banerjee, Sean; Banerjee, Hatasha Kholgade
Mentor: Banerjee, Hatasha

We present GraspPC, an approach to perform learning-based synthesis of multiple human hand grasps as point clouds from point clouds of objects. GraspPC benefits human-robot handover approaches by providing hypotheses of human grasp on objects to inform robotic manipulation algorithms on how to bias robotic grasp for safe handover. Existing learning-based approaches to conduct hand grasp prediction require datasets to contain annotated articulated hand models, making them difficult to train on datasets that lack hand model annotations. GraspPC treats the problem of hand point cloud generation from object point clouds as a set-to-set translation problem. We contribute a Transformer architecture to synthesize point clouds via GraspPC. To generate diverse hand grasps, we generate multiple object-dependent queries and train the network using a winner-takes-gradient strategy. We show results of diverse grasps by training and testing on a variety of real-world datasets. We demonstrate how human grasps generated by GraspPC can be used to filter robotic grasp candidates to inform human- robot handover.

121 Surface Electromyography-based Robotic Release in a Robot Human Handover Scenario

Megyeri, Ava Maria; Banerjee, Natasha; Banerjee, Sean
Mentor: Banerjee, Natasha

This demo showcases how physiological sensing via surface electromyography (sEMG) enhances robot-human interaction by informing the robot of the human's intent to grasp an object. By continuously monitoring sEMG signals, the robot detects the human’s grasp intent in real time and releases the object only when muscle activation exceeds a predefined threshold. This approach ensures precise and adaptive grasping behavior, eliminating the need for manual force calibration. By leveraging sEMG-based intent detection, the system improves responsiveness and fluency in human-robot interactions, paving the way for more natural and intuitive robotic collaboration.

122 Using Human-Human Handover Data to Analyze Giver and Receiver Timing Relationships During the Pre-Handover Phase

Megyeri, Ava Maria; Kyrarini, Maria; Banerjee, Sean; Banerjee, Natasha Kholgade
Mentor: Banerjee, Natasha

The fluency of handover between two agents is important to ensure safety and success of handover. In this work, we study the relationships between the timings of giver and receiver motions in human-human handover interactions, to inform human-robot handover. We use giver and receiver hand trajectories from the Human-Object-Human (HOH) handover dataset to study movement during the pre-handover phase, prior to the point of transfer. We find that human receivers adopt a largely proactive behavior, and plan and start motion early in the pre-handover phase. We also find that human receivers spend much of their motion moving in coordination with the giver, rather than after the giver has reached the transfer point. Further, we find that human receivers may predict future movement of the giver from early giver motion, and adjust their start times accordingly to ensure coordinated grasp at transfer. Our findings suggest that robot receivers should adopt a predictive giver-aware approach to plan motion early, and robot givers should recognize that human receivers may expect giver behavior to be human-like and predictable.

75 Automation of Industrial Electropolishing using Real-Time IoT-Based Control

Saleh, Nermeen Mohi; Amsaad, Fathi; Ibrahem, Mohamed I.; Salehi, Hugh
Mentor: Amsaad, Fathi

This paper introduces a novel Internet of Things (IoT)-based smart electropolishing system designed to enhance precision, safety, and efficiency in industrial processes. By integrating an ESP32 microcontroller with temperature, current, and Total Dissolved Solids (TDS) sensors, the system automates critical monitoring and control tasks. This ensures optimal temperature regulation, solution purity, and material removal through real-time feedback and automated shutdown mechanisms. The temperature sensor regulates solution temperature by pausing the process during overheating, the current sensor calculates material removal, and the TDS sensor ensures process efficiency by alerting operators to replace contaminated solutions. A NodeRED-based user interface enables real-time monitoring and remote management, addressing health and safety concerns, such as hazardous fumes. The proposed system not only highlights the potential of IoT networks in advancing industrial processes but also provides an adaptable solution for maintaining human safety. This project marks the first step toward automating electropolishing processes. Key challenges such as sensor calibration, system latency, and multi-user interface design are resolved, demonstrating the potential of IoT in modernizing industrial manufacturing.

76 Convex LDA: A Supervised Dimensionality Reduction Approach for Improved Class Partitioning in High-Dimensional Hypoxia and Acute Motion Sickness Data

Surineela, Sai Vijay Kumar; Ghosh, Tomojit
Mentor: Ghosh, Tomojit

Convex Linear Discriminant Analysis (Convex LDA) is a novel supervised linear dimensionality reduction technique designed for high-dimensional biological datasets. It optimizes a convex cost comprising two complementary terms: one that ensures in-class clusters are highly condensed and another that maximizes inter-class separation by expanding the hyperelliptic scattering volume through the logarithm of the determinant (log-det) of the outer product matrix formed by class centroids in the embedded space. Unlike traditional LDA, which struggles to faithfully project classes in low-dimension for high-dimensional data, the proposed model preserves the class separation in embedding space, enabling higher efficiency. To validate its effectiveness, we apply the presented approach to various high-dimensional biological datasets (Hypoxia, AMS, and Motion Sickness datasets). These datasets pose challenges for classical LDA due to their complex feature spaces, where conventional LDA often fails to partition classes effectively, leading to suboptimal classification performance. Convex LDA overcomes this limitation by preserving meaningful class separations even in high-dimensional, nonlinear biological data. Our results confirm that Convex LDA significantly enhances class discrimination and model performance, making it a superior choice for supervised linear dimensionality reduction.

Department of Electrical Engineering

77 Bi-layered Silicon with Strain Induced Tunable Optical Properties for IR Applications

Narra, Nihal; Vishal, Kumar; Ji, Zhonhang
Mentor: Zhuang, Yan

Bilayer silicon finds variety of applications with its wide range optical and electrical properties. Exceeding a strain threshold of 12.26% will open-up bandgaps resulting an induced inter-band optical transitions at mid infrared wavelengths and increase in refractive index.

Department of Mechanical and Materials Engineering

78 Additive Manufacturing of Inconel 718 and Stainless Steel 316L as Preforms for Forging

Ahsan, Showmik; Mian, Ahsan; Young, Daniel; Srinivasan, Raghu; Asam, Vignesh; Borker, Tushar; Kusekar, Sambhaji

Mentor: Young, Daniel

Laser Powder Bed Fusion (LPBF) techniques provide notable advantages for manufacturing applications requiring intricate geometries and low production volumes, making them particularly valuable in the aerospace industry for producing critical metal components. This research investigates the use of LPBF to fabricate preforms from Inconel 718 and 316L stainless steel, which are subsequently processed through forging and finishing. Our study focuses on the impact of compressive strain on the microstructure and recrystallization behavior of additively manufactured IN718 and 316L materials, considering variables such as temperature, strain, and strain rate. This report presents preliminary findings that reveal variations in microstructure, mechanical properties, and defect density. Gaining insights into these factors is crucial for optimizing forging processes and ensuring that final components meet the stringent standards of the aerospace industry. By addressing the integration of additive manufacturing with traditional metalworking, this work aims to advance the performance and reliability of aerospace components.

79 Optimization of Preform Design in Additive Manufacturing-Assisted Forging Using Computational Techniques

Asam, Vignesh; Ahsan, Showmik; Ahsan, Mian; Young, Henry D.; Srinivasan, Raghavan
Mentor: Ahsan, Mian

Forging is essentially used in aerospace, automotive, and heavy industries for producing high-strength and critical components, where defect-free manufacturing relies on optimal preform design. To prevent defects like underfill, surface cracks, and cold shuts, efficient optimization is crucial to reduce reliance on costly and time-consuming trial-and-error methods. Additive manufacturing (AM)-assisted forming can help in reducing preform stages and enables complex shapes to be manufactured, but its integration with simulation tools remains underexplored. This research focuses on optimizing preform design for additive manufacturing (AM)-assisted forging using computational techniques. MATLAB and cubic splines are employed to generate and refine preform geometries, allowing for smooth and flexible shape adjustments to optimize strain distribution enough for recrystallization in deformed parts. By leveraging cubic splines, various preform shapes are systematically analyzed to enhance strain distribution, material flow and reduce defects. Finite Element Analysis (FEA) using Simufact-Forming is used to simulate the forging of Inconel 718 and Stainless Steel 316L. The effects of preform shape, stroke length, stroke rate, friction, and temperature on stress and strain distribution are evaluated. These simulations aid in identifying optimal preform geometries and forging conditions, improving efficiency, reducing process costs, and advancing the integration of AM in metal forming.

80 Exploration of Data Science and Machine Learning Techniques for Wildfire Prediction

Ballentine, Rachael; Raymer, Michael
Mentor: Raymer, Michael

Wildfires are defined as unplanned and uncontrolled fires that occur in areas with combustible materials. According to the National Interagency Fire Center, there were over 50,000 wildfires across the US in 2023 alone, affecting almost 3 million acres of land. Ignition and spread of these fires depend on a number of factors, including seasonal weather conditions, available fuel, topography, and proximity to populated areas. Prediction and management of wildfires is a complex but critical problem, as the wildfire crisis continues to develop in conjunction with the rise of global temperature and greenhouse emissions. In this project, data science and machine learning techniques will be applied to a prediction problem in this field. A range of methods will be applied to an identified data set, from exploratory data analysis and interpretive techniques to more complex approaches like neural networks.

81 Gamma Radiation Attenuation of Additively Manufactured Polymers

Clark, Lucas A.; Ouchen, Fahima; Davidson, Laura; Bartsch, Carrie; Heckman, Emily; Mian, Ahsan

Mentor: Mian, Ahsan

Ionizing radiation is a high priority concern for long-term and deep-space missions. Radiation can cause instantaneous and long-term damage to sensitive electronics. Gamma rays are one type of radiation and are highly penetrative. Current strategies for protecting electronics from radiation include adding redundant components, using error-tolerant code, switching to alternative radiation hardened components, or placing a shield around sensitive devices. Additional components increase the cost, weight, and complexity of the entire system. Error-tolerant code has limitations and is of no benefit if the component is significantly damaged or destroyed. Some components do not have radiation hardened alternatives. The development of these alternatives can have large lead times and be costly. Typically, radiation shields are made of high density and high atomic weight materials. Adding a shielding layer of lead or depleted uranium, toxic metals commonly used, may be the easiest to implement, but increases weight and cost. This research aims to find alternative materials that can be lightweight, amenable to low cost, rapid deposition processes, and effective at shielding against gamma radiation. Phy-X/PSD software was used to calculate the half value layer and linear attenuation coefficient of several materials at multiple gamma ray energies. The shielding capabilities of additively manufactured polylactic acid (PLA) and polyamide, as well as commercial aluminum and lead sheets, were measured using a Geiger-Müller radiation counter when exposed to a Cesium-137 and Cobalt-60 source. To prevent the detector from counting beta rays coming from the gamma sources, a PLA beta shield was created. The gamma attenuation of all the materials were tested both with and without the beta shield. The attenuation results better matched the calculations when using the beta shield. Future research will utilize this software for designing new promising shielding materials and these new materials will be experimentally measured using the Geiger-Müller radiation counter.

82 Numerical Simulations on Aerodynamics of Dual S826 Airfoils

Esehac, Rania Mohmmed Qurashi; Yi, Hang; Yang, Zifeng
Mentor: Yang, Zifeng

Achieving high aerodynamic efficiency in dual-wing configurations under various flow conditions is a significant aero-design challenge. Conventional single-wing concepts do not fully leverage the potential benefits of dual-wing systems, including obtaining higher lift-to-drag ratios and improved aerodynamic stability. To overcome these limitations, this study employs a dual-airfoil configuration of a S826 airfoil at Reynolds numbers of 60,000 and 100,000 with different gaps, staggers and decalage to assess its aerodynamic performance using Computational Fluid Dynamics (CFD). Mesh sensitivity study was conducted to precisely select the proper mesh refinement to run the simulation. Reynolds-averaged Navier stokes equations RANS were performed with two turbulence models, namely $k{-}\omega$ SST with transition model Langtry– Menter $\gamma - Re\theta$ and $k{-}\varepsilon$ fully turbulent model which are well-known for their accuracy in determining critical aerodynamic parameters such as lift, drag, and pressure coefficient distribution. Those models were implemented for single wing configuration with the same airfoil section at a low Reynolds number of 100,000 and proved their ability to accurately predict the aerodynamic parameters and capture the aerodynamic phenomena such as separation bubbles when validated by experimental data from the NTNU wind tunnel test. The estimated results for dual air configuration are validated by experimental tests, which were carried out at a low-speed open circuit wind tunnel at Wright State University, to ensure the accuracy and reliability of the computational models for the dual airfoil configuration. All simulation boundary conditions and flow conditions are set to match the wind tunnel tests since turbulent models are sensitive to the boundary conditions like turbulence intensity, free stream velocity and Reynolds number. The simulation results show good agreements with the experimental data.

83 Processing and Characterization of Functional Nanoparticle Inks for Flexible Hybrid Electronics

Singh, Arashdeep; Mian, Ahsan
Mentor: Mian, Ahsan

Inkjet printing provides a straightforward approach for creating flexible hybrid electronics devices of the next generation. This study focuses on the complex connections between materials, processes, and resulting properties, especially focusing on emerging functional materials such as nanomaterials, polymers, and composites. As such, we processed, printed and characterized the conductive (Nano silver) and dielectric (polyimide and polyimide/BaTiO3 nanocomposite) ink-based materials for heterogeneous integration and sensor applications. The ceramic/polymer dielectric composite material was considered for further improvement in dielectric properties of the material. The Nanocomposite ink was also processed by vary the percentage of BaTiO3 nanoparticles. Following the inkjet printing process, the thickness of the printed layers was measured using a probe profilometer. The printed materials were then characterized using high-resolution imaging through scanning electron microscopy (SEM) and elemental analysis with energy-dispersive X-ray spectroscopy (EDX). This comprehensive approach provides valuable insights into the development of inkjet-printed materials for advanced electronic applications.

84 Inception and Rupture of Intracranial Aneurysms with Daughter Sacs: A Comprehensive Hemodynamics Analysis

Yi, Hang; Bramlage, Luke C.; Yang, Zifeng; Ludwig, Bryan R.
Mentor: Yang, Zifeng

Intracranial aneurysms (IAs) with daughter sacs (DSs) have an increased risk for rupture yet the hemodynamic factors contributing to DS pathophysiology are still under-investigated. This study investigated hemodynamic factors in DS generation and rupture using anatomic and ablated IA models under various DS scenarios. Methods—113 computational models of 43 patients with at least one IA owning with DS symptoms were built based on 3D rotational angiographical images using benchmarked model reconstruction procedures. Of these 43 patients, 19 ruptured (RIAs) and 26 unruptured IAs (UIAs). Hemodynamic Models Ablated models representing the aneurysm before DS formation were rebuilt by virtually ablating the blebs from the anatomic models. In-vitro-validated computational fluid dynamics simulations were conducted for both the anatomic IA and ablated IA models under physiologically pulsatile flow conditions. Wall shear stress (WSS) associated parameters were used to analyze the hemodynamic factor on the DS pathophysiology statistically. Results and Discussion—There was a statistically significant difference seen between RIAs and UIAs in hemodynamic performances at the entire aneurysmal sac region.

College of Health, Education, and Human Services

Department of Teacher Education

85 Elementary Teacher Candidates Learn about Project-based Learning (PBL) by Participating in a PBL Partnership with High School STEM Students

Martin, Emily J.; Fleming, Michelle
Mentor: Fleming, Michelle

This case study explores how sixty-three undergraduate elementary teacher candidates (n=63) deepened their understanding of Project-based Learning (PBL) by actively participating in a PBL experience alongside tenth graders at a local high school. Rather than learning about PBL through more traditional methods (i.e. reading about PBL, teacher-modeled examples of PBL experiences, lectures, etc.), candidates engaged in collaborative, inquiry-driven learning on the interdisciplinary topic of nutrition, mirroring the instructional strategies they aim to implement in their own STEM classrooms. Grounded in experiential learning theory and PBL, this study examines the role of active engagement in authentic tasks to deepen pedagogical understanding. Teacher candidates constructed knowledge and skills through direct experience, reflection, and application. Through a mixed methods analysis of reflections, observations, and artifacts from the experience, several themes emerged: (1) Shifting teacher identity – candidates transitioned from knowledge transmitters to facilitators of student-driven learning; (2) Navigating collaborative dynamics – working with high school students challenged candidates to balance leadership with partnership; (3) Embracing authenticity in learning – candidates recognized the power of real-world connections in fostering deeper student engagement; and (4) Developing adaptive expertise – candidates gained confidence in being flexible, uncomfortable, and responding to the needs of the partnership and their students in a dynamic learning environment. Findings suggest that immersive PBL experiences can be a transformative approach for teacher candidates, reinforcing the importance of student-centered teaching methods while preparing them for the complexities of becoming a classroom teacher. The impact of the partnership and implications for teacher preparation will be shared.

College of Health, Education, and Human Services

School of Professional Psychology

86 Dissociative Identity Disorder (DID)- Investigating a Misunderstood Diagnosis Across History and Cultures

Medis, Minuki; Karimzadeh, Mona; Hilt, Celine
Mentor: Bielek, Sara

Dissociative Identity Disorder (DID), previously known as multiple personality disorder, is a psychological disorder where the client experiences an assortment of stages of dissociation and different identities called “alters”. The DSM-5-TR outlines key diagnostic criteria, such as the presence of two or more distinct personality states, disruptions in identity, and recurrent memory gaps that cause significant distress/impairment (American Psychiatric Association, 2022). DID has been frequently misdiagnosed due to a lack of information, but it’s slowly being better researched. Our presentation explores what DID is, the diagnostic criteria, and multicultural influences.

College of Liberal Arts

School of Humanities and Cultural Studies

87 Maritime Conflict and the Portrayal of Piracy in Early Modern Literature

Christner, Gabrielle Elie
Mentor: Higgins, Steve

Pirates have become a popular research topic for a variety of literary analyses, often focusing on either the historical or fictional accounts of piracy as ruthless and lawless individuals. As such, this proposal explores how the historical contextualization of piracy shaped the way in which English authors portrayed pirates, often encouraging pro-English sentiments through their character's physical descriptions and behaviors. This proposal investigated several primary sources, including both Queen Elizabeth's proclamation condemning piracy in England. In addition, this proposal introduced several secondary sources that illustrated the ways in which England employed privateers as "legal pirates," illustrating the complex use of piracy as a weapon of conflict and global expansion. In addition to these sources, this proposal analyzes several Early Modern English plays such as Phillip Massinger's The Renegado and William Shakespeare's Hamlet. Each play includes a non-English pirate who steals from the "English" protagonist, villainized through their physical descriptions and immoral actions. In Hamlet and The Renegado, however, the pirates redeem themselves by helping an English character return home safely. As such, the exploration of fictional pirates reveals how England condemned the use of piracy while also attempting to utilize it for their own power. Overall, this proposal aims to explore the concept of piracy and its transformation throughout the Early Modern period as imperial powers fought for maritime power and global expansion. By creating complex literary portrayals of piracy, England encouraged its use of privateers to provide stability and power as they fought to expand their sphere of influence through commerce, conquest, and conflict.

88 The Foreigner in Our Midst: Jewish Rights Debates in The Foreigner in Our Midst: Jewish Rights Debates in Revolutionary France

Evans, William Earl

Mentor: Pollock, Sean

The debates surrounding Jewish rights during the French Revolution concerned many of the same subjects that divide the Western world today. The fear of the other, immigration as a political tool, and the disagreements over assimilation are all subjects which feature prominently today. In this essay I set out to explore these debates while fairly assessing the historical informants. Beyond gaining a greater understanding of the period, writing and revising this essay improved my ability to write clearly and effectively. I am grateful to Dr. Pollock for his dedication to his students as well as his continual guidance.

89 Computer Assisted Human Translation Versus Computer Translation

Koeller, Deanna; Halabi, Awad; Halling, Kirsten; Abadie, Pascale; Crusan, Deborah
Mentor: Halabi, Awad

Nowadays, individuals rely extensively on computer software and AI for translations. These translations, while communicating useful information, often do not portray the correct meaning and tone of the original text. In my paper, I will argue that Computer-Assisted Human Translation is superior to Machine Translation due to a human being's knowledge of language and culture. I intend to prove this theory by performing a Computer-Assisted translation of the novel "Les Chats Ont Neuf Vies, Moi, J'En Aurai Deux" by Julien Aime, doing a translation using only Google Translate, another using only Chat GPT, and comparing these translations.

90 Inclusive Approaches to Teaching African American History Rooted in Decolonial Pedagogy and Praxis

Tassy, A L
Mentor: Halabi, Awad

In the contemporary educational landscape, the notion of a "post-colonial" era often obscures the enduring legacies of colonialism, capitalism, and imperialism that continue to shape societal structures. At predominantly white institutions (PWIs) like Wright State University, where investments in the military-industrial complex and corporate partnerships prevail, students are often funneled into roles that uphold the status quo, discouraging engagement with historical injustices such as Indigenous genocide and African enslavement. A significant gap in this framework is the lack of representation of African American LGBTQ+ and disabled individuals in university curricula. While many African American history courses focus on cisgender, heterosexual, able-bodied men and organizations like the Black Panther Party or SNCC, the contributions of queer, disabled, and working-class African Americans are frequently overlooked, perpetuating a narrow understanding of African American history. To address this, my project proposes an inclusive curriculum for introductory African American history courses, incorporating primary and secondary sources, lesson plans, and multimedia materials that highlight marginalized voices, such as Gladys Bentley's story as a drag king during the Harlem Renaissance and the Black Panther Party's involvement in disability rights through the 504 protests. Emphasizing praxis (theory + action) and intersectionality, the course centers the experiences of African American queer, disabled, and working-class communities, fostering inclusion and belonging through critical pedagogy, active engagement, and collective action. While universities are not inherently liberatory, this course seeks to empower students to apply their learning beyond institutional walls, transforming education from a tool of compliance into a catalyst for liberation. By teaching this course for free in my community and encouraging others to do the same, I aim to make inclusive education accessible and actionable, equipping students to dismantle oppressive systems and build a more equitable future.

College of Science & Mathematics

Department Chemistry

91 Exploring the Impact of Side-Chain Crystallinity in Sulfonamide Polymers

Koster, Mason Andrew; Fossum, Eric
Mentor: Fossum, Eric

Applications of polymers have shown significant growth in the world's electronic, industrial, and scientific fields because of the thermal transition properties polymers provide. Thermal properties like the Tg, Tc, and Tm allow for vast applications. These polymer thermal properties can be tailored by tuning the structure of the side-chains. Side-chain crystallinity provides more crystallinity in the polymer without changing the backbone. Long alky side-chains provide strong intermolecular forces that allow them to crystallize, which is a necessity for tuning thermal properties. Sulfonamides provide a pathway to synthesize long N,N-alkyl chains to tune the thermal properties of Poly(aryl ether) polymers.

92 Unmasking the Hidden Dangers: Detecting Toxic Contaminants in Drinks by Raman Spectroscopy

Rutkowski, Riley; Cox, Kai; Hazel, Autumn; Moore, Keaira; Nyumah, Lov
Mentor: Lunsford, Suzanne

Raman spectroscopy has emerged as a valuable tool for detecting contaminants such as antifreeze in drinks and for applications in forensic chemistry. The technique utilizes the inelastic scattering of light to identify molecular vibrations, providing a fingerprint for chemical identification. In the context of detecting antifreeze (ethylene glycol or propylene glycol) in beverages, Raman spectroscopy can differentiate these compounds from other substances based on their unique Raman spectra. The distinct peaks corresponding to specific chemical bonds enable rapid, non-destructive analysis without the need for sample preparation. Additionally, Raman spectroscopy is highly effective in identifying common organic compounds—such as alcohols, ketones, and sugars—by analyzing their characteristic vibrational modes. Our project will illustrate how this is a versatile tool for determining the composition of liquid samples, allowing for the detection of contaminants, the identification of unknown substances, and the confirmation of the purity of liquids in forensic and regulatory contexts.

93 Road Salt Contamination in Wright State Stream Water: Environmental Analysis

Sparkman, Benson; Bingamon, Megan; Shafer, Nathan; Mann, Margaret
Mentor: McGowin, Audrey

Research on the streams' water in Wright State's woods has been ongoing since 2018. Seven years later, sampling of chloride contamination is still being conducted, with no significant progress made to reduce the amount of road salts contaminating Wright State's wood. Last year's winter data indicated chloride levels exceeding the EPA limit for drinking water by more than twice the limit, with concentrations being 30 times higher than the average in natural streams. This semester, the question we are exploring is whether this issue is specific to Wright State and whether the harsh winter will lead to even higher contamination levels. We plan to gather samples from The Little Beaver Creek, which runs along the major highway 35, and compare them to the data from this winter.

94 Investigating the Impact of Bond Distance Between Au(I)-Carbon in NHC Compounds on TrxR Inhibition and IC50 in Cancer Lines

Stracener, Wynema; Arumugam, Kuppuswamy; Lofino, Justin; Krupaben, Patel; White, Zack; Jayaraman, Selvakumar

Mentor: Arumugam, Kuppuswamy

The widespread effect of cancer drives a necessity for less detrimental and invasive treatments. Previous studies have established that N-heterocyclic-Au(I)-carbene compounds inhibit TrxR, an overexpressed enzyme known to cause cellular dysregulation in cancers. The role that bond length between Au(I) and its carbene has on the inhibition of TrxR in our compounds is unknown. Varied by substituents on the imidazolium backbone and nitrogen atoms, proper bond length may alter binding at the active site of TrxR and positively impact conformational flexibility, increasing inhibition of TrxR and allowing for increased efficacy in blocking the ability of cancer cells to regulate reactive oxygen species. Our research goal is to experimentally explore the effect that varying bond lengths has versus IC50 values and TrxR inhibition with Au(I)-carbenes.

Department of Biochemistry and Molecular Biology

95 Protein-mediated Polyphosphorylation of Nanostructured Biocomposites for Thermal Protective Systems and Beyond

Eitmontas, Bella; Slocik, Joseph M.; Lombardo, Nina V.; Crenshaw, Michael; Farajollahi, Sanaz; Dennis, Patrick B.; Mirau, Peter A.

Mentor: Dennis, Patrick B.

Inorganic polyphosphates (PolyP) are linear polymers of tens to hundreds of orthophosphate residues, linked together by high-energy phosphoanhydride bonds. Polyphosphorylation of target protein sequences was recently discovered as a post-translational modification used to control nuclear function in cells. Notably, PolyP has been shown to spontaneously and non-enzymatically react with proteins containing polyacidic serine- and lysine-rich (PASK) domains. However, the conditions that promote covalent interactions between PolyP chains and PASK domains remain unclear. The primary objective of this research is to engineer self-assembling biocomposites made from PASK-containing proteins that can be polyphosphorylated non-enzymatically with PolyP. This approach seeks to create nanostructured composites suitable for thermal protective systems and other Air Force applications. We hypothesize that the microenvironment in liquid-liquid phase separation (LLPS) droplets is crucial for the covalent attachment of PolyP chains to the PASK domains. To explore this hypothesis, we have designed a synthetic biology toolkit for the expression of PASK domains, which we are combining with a library of PolyP chains of varying molecular weights to elucidate the underlying mechanisms of PolyP interaction. Our research methodology integrates a multi-faceted approach, including gel electrophoresis, pull-down assays, microscopy, NMR spectroscopy, and colorimetric assays, to quantify the interactions between PolyP and the PASK domains. Gel electrophoresis methods were developed and tested to distinguish between ionic and covalent interactions between PASK domains and PolyP. Through these investigations, we aim to advance the understanding of PolyP's interaction with PASK domains and its potential applications in biocomposite materials.

96 Lipin1 as a Potential Therapeutic Approach for the Treatment of Cardiac Abnormalities in Duchenne Muscular Dystrophy

Kamau, John Karanja
Mentor: Ren, Hongmei

Cardiomyopathy is the leading cause of death in Duchenne muscular dystrophy (DMD) patients. DMD is caused by mutations in the dystrophin gene, which plays a major role in maintaining cardiac membrane stability and protecting it from contraction-induced damage. As a result, dystrophin mutation in DMD leads to sarcolemmal instability, inflammatory cell infiltration, cellular death, and fibrosis of the cardiac muscles, eventually leading to cardiomyopathy. Currently, there is no cure for the disease. Lipin1 has dual functions acting as phosphatidic acid phosphatase required for lipid synthesis and as a transcriptional coactivator. Our current study shows that lipin1 is critical in maintaining membrane integrity and stability in the skeletal muscles of the mdx mouse model for DMD. In this study, we assessed the potential therapeutic effects of lipin1 restoration in ameliorating mdx cardiac pathology using a gene delivery approach.

97 MyoAAV-mediated Lipin1 Restoration Reduces Dystrophic Diaphragm Muscle Pathology

Sakshi, Sakshi

Mentor: Ren, Hongmei

Respiratory failure is a leading cause of death in Duchenne Muscular Dystrophy (DMD), which is characterized by severe skeletal muscle degeneration, particularly affecting the respiratory muscles like the diaphragm. DMD is caused by mutations in the dystrophin gene, which leads to sarcolemmal instability and structural deterioration of the diaphragm muscle tissues. Our previous studies have shown that lipin1 plays a complementary role to dystrophin in restoring sarcolemmal integrity. This study explores the therapeutic potential of MyoAAV-mediated lipin1 gene therapy in alleviating diaphragm muscle pathology associated with dystrophic conditions. Our research demonstrates that restoration of lipin1 delivered via MyoAAV vector significantly reduced inflammation, fibrosis, and myofiber death. These findings suggest that MyoAAV-mediated lipin1 gene therapy is a promising strategy for treating respiratory complications in DMD, ultimately enhancing the quality of life of the patients.

Department of Biological Sciences

98 Exploring the Role of Mitochondria-Associated Genes in Modulating α-Synuclein Toxicity in Yeast

Biswas, Kamalika; Zhong, Quan
Mentor: Zhong, Quan

Parkinson's disease (PD) is the second most common age-related neurodegenerative disorder, characterized by the progressive loss of dopaminergic neurons in the substantia nigra. A hallmark of PD pathology is the misfolding and accumulation of the α-synuclein protein, which disrupts mitochondria. Misfolded α-synuclein impairs complex I activity in the electron transport chain (ETC) and increases reactive oxygen species (ROS) production. This, in turn, promotes further α-synuclein misfolding and mitochondrial damage, creating a harmful cycle. While several familial PD-associated genes have been shown to regulate mitophagy, a process essential for mitochondrial quality control, the causes of most sporadic PD cases remain unknown. Some, however, have been linked to environmental factors that damage mitochondria. Despite different origins, many PD mechanisms lead to mitochondrial dysfunction, resulting in the selective loss of dopaminergic neurons. To further explore genetic factors involved in α-synuclein toxicity and mitochondrial dysfunction, this study utilizes yeast, a genetically tractable organism, as a model to study human genes that promote α-synuclein toxicity. Overexpressing α-synuclein in yeast cells causes toxicity, similar to what happens in neurons. Our lab has identified 34 human gene clones that, when co-expressed with α-synuclein, induce its toxicity in yeast. We plan to systematically assess the impact of these genes on α-synuclein accumulation and mitochondrial function to uncover potential contributors to PD pathology.

99 RNA-Binding Protein RBM14 Rescues ALS-Associated FUS Toxicity in Yeast

El-Zein,Widad; Hayden, Elliott; Chen, Shuzhen; Zhong, Quan; Ju, Shulin
Mentor: Ju, Shulin

Amyotrophic Lateral Sclerosis (ALS) is a progressive neurodegenerative disease characterized by motor neuron loss. Several RNA-binding proteins (RBPs), including Fused in Sarcoma (FUS), have been linked to ALS, yet its pathological mechanisms remain largely unclear. Key ALS-associated features, such as protein aggregation and toxicity from misfolded proteins, can be effectively modeled in Saccharomyces cerevisiae, a eukaryote with conserved cellular processes. A yeast model of FUS recapitulates its cytoplasmic mislocalization, aggregation, and dose-dependent toxicity, mirroring ALS neurons. Using the yeast model, our lab performed a genome-wide screen to identify human genes that suppress FUS-induced toxicity in yeast. Among them, RBM14 stood out as a multifunctional RBP involved in transcriptional regulation, RNA splicing, DNA repair, immune responses, and stress adaptation. RBM14 shares structural similarities with FUS, allowing it to aggregate in mammalian cells and function in RNA processing. Notably, RBM14 also suppresses toxicity of other ALS-linked RBPs, including TDP-43 and Matrin-3, suggesting a broader role in ALS pathology. Mounting evidence indicates that FUS aggregation disrupts cellular stress responses by driving persistent stress granule (SG) and P-body formation. Our lab's data confirm that FUS induces these structures and colocalizes with them. Since these structures regulate cellular stress responses, FUS mislocalization may lead to sequestration of essential RNAs and proteins, impairing normal SG and P-body function. We hypothesize that FUS toxicity arises from its disruption of RNP granules and that RBM14 alleviates this effect. In this study we investigate the suppressive effect of RBM14 on FUS and the relationship between cellular stress response and cytotoxicity.

100 Microbial Movers and Shapers: Identifying Evolutionary Drivers of Belowground Microbial Communities

Greene, Madeline Robertson; Slaughter, Mariah; Addison, Sarah; Wakelin, Steve A., Rúa, Megan A.

Mentor: Rúa, Megan A.

Microorganisms influence plant success by affecting nutrient cycling, stress resistance, and species establishment, leading to a high degree of evolution between the two organisms. However, the extent to which deterministic evolutionary processes, like natural selection, drive this relationship compared to stochastic evolutionary processes, like genetic drift, is largely unknown, especially at large spatial scales. To bridge this knowledge gap, we are quantifying belowground microbial communities of Pinus radiata in multiple locations along its historical, endemic range following its reintroduction from New Zealand after centuries of plant breeding. To assess which evolutionary processes are driving the composition of microbial communities, we will use null model testing to distinguish deterministic from stochastic processes. Microbial community turnover will be quantified using the Beta Nearest Taxon Index (βNTI), a metric that compares the phylogenetic similarity of two communities using microbial sequence abundance data, where βNTI values > 2 or < -2 indicate selection, and βNTI values between -2 and 2 suggests drift. Principal components analysis will be used to explain whether microbial selection is driven by environmental factors and if so, which factors. Understanding the drivers behind evolutionary processes experienced between microbial communities and their plant hosts will enhance our abilities to predict microbial responses to environmental shifts, informing management of plant-microbe interactions and future conservation strategies.

101 Callicarpa Dichotoma: An Ecological Comparison of Traits in an Emerging Invasive Plan

Grine, Mesa Christine; Cipollini, Don
Mentor: Cipollini, Don

Most instances of invasive plant species can be directly traced to anthropogenic sources. Invasive plant species pose various threats to the native flora and fauna. They tend to have increased resistance to native herbivory, a greater ability to obtain and exploit nutrients, have high dispersal rates, contain allelopathic chemicals, and have a successful relationship with urbanized areas. Maintenance of these destructive plants also comes with a high cost. In this study, we focused on an Asian plant species found growing in and around a university campus located in southwestern Ohio. Callicarpa dichotoma (Asian beautyberry) is planted ornamentally for its moderate size and showy purple berries. It has reports of invasive tendencies according to findings of similar invasive shrubs and its ability to persist in a variety of conditions. Our aim in this study is to investigate the invasive tendencies of Asian beautyberry and discuss its level of conservation concern. To determine this, we are going to investigate its tolerance, herbivory, growth rate, apparent nutrient availability, and its overall likelihood of being detrimental to foreign habitats. We suspect it will outperform native plants of similar characteristics and will perform similarly to invasive plants with alike characteristics. Keywords: Asian beautyberry, invasive plant species, resistance, tolerance, competition.

102 Investigating the Impact of the α-Synuclein and its Enhancer Optineurin on Yeast Organelle Organization

Haider, Ishita; Islam, Md Moydul; Almazan, Annabel V.; Scott, Lauren; Gillespie, Breonna; Chen, Shuzhen; Ju, Shulin; Zhong, Quan

Mentor: Zhong, Quan

Parkinson's disease (PD) is associated with the abnormal accumulation of α-synuclein, a lipid-binding protein involved in intracellular trafficking. Optineurin (OPTN), a multifunctional adaptor protein linked to autophagy and membrane trafficking, has been identified as an enhancer of α-synuclein toxicity. However, the underlying enhancer mechanism remains unclear. In this study, we investigated the impact of α-synuclein and OPTN co-expression in yeast, using fluorescence microscopy with organelle-specific markers to assess organelle integrity. Our results show that OPTN colocalizes with α-synuclein and is associated with significant alterations in endomembrane compartments. In particular, endoplasmic reticulum, vacuolar and Golgi structures exhibited distinct morphological changes, suggesting disruptions in organelle homeostasis. These findings indicate that OPTN influences α-synuclein's subcellular localization and may contribute to organelle dysfunction. Understanding this interaction in a simplified model system could provide insights into cellular mechanisms relevant to PD pathology.

103 Investigating the Enhancer Effect of Membrane Trafficking Proteins on α-synuclein Toxicity in Yeast

Minassian, Christina; Yadav, Sonu; Chen, Shuzhen; Chi, Yali; Haider,Ishita; Hayden, Elliott; Ju, Shulin; Zhong, Quan

Mentor: Zhong, Quan

Parkinson's disease (PD) is a neurodegenerative disorder characterized by tremors, postural instability, and muscular rigidity. Central to PD is the alpha-synuclein protein encoded by the SNCA gene. Alpha-synuclein is primarily expressed in the substantia nigra of the brain. Mutations in the SNCA gene lead to abnormal accumulation of alpha-synuclein and the formation of toxic protein aggregates called Lewy bodies in neurons, disrupting cellular functions. Genome-wide genetic screens in yeast have identified 17 human genes that enhance alpha-synuclein-induced cellular toxicity, possibly by interfering with membrane trafficking pathways. My project aims to study the role of these enhancer genes in yeast cells, focusing on their impact on vesicular transport. Ultimately, this work may help to identify new therapeutic targets for treating PD.

104 Manipulating CO2 to Alter Central Chemosensitivity in the Tadpole Model System

Poeppelman, Cassandra Lynn; Hartzler, Lynn
Mentor: Hartzler, Lynn

The sensitivity of chemosensory neurons controlling ventilation can be altered by environmental factors like long-term increases in CO2 (chronic hypercarbia). Studying the mechanisms of this change in sensitivity is applicable to many respiratory diseases but is complicated by the limitations of common mammalian models. Our systematic review of animal models searched for species that would allow direct manipulation of gaseous exposure during development, possess similar development and control of central respiratory circuits, and provide physiologically relevant neuronal recordings. Search results suggest the best model for the development of central respiratory sensitivity is the tadpole of the American bullfrog (Lithobates catesbeianus).

105 Investigating RPB7-Mediated Suppression of ALS-associated TDP-43 Toxicity and Stress Granule Dynamics in the Yeast Model

Shah, Rahul M.; Hayden, Elliot; Alspaugh, Cassidy; Zhong, Quan; Ju, Shulin
Mentor: Ju, Shulin

Amyotrophic Lateral Sclerosis (ALS) is a fatal neurodegenerative disease characterized by motor neuron degeneration, muscle atrophy, and respiratory failure. A key pathological feature is the mislocalization and aggregation of TDP-43, an RNA-binding protein involved in RNA transcription, splicing, and stability. These cytoplasmic aggregates are observed in both familial and sporadic ALS and are believed to contribute to neuronal toxicity through either loss of nuclear function or toxic gain of function. TDP-43 also regulates ribonucleoprotein granules, including stress granules, which form under cellular stress to protect untranslated mRNA. In ALS, persistent TDP-43-containing stress granules disrupt RNA homeostasis, exacerbating toxicity and neuronal dysfunction. Using the budding yeast model, which recapitulates TDP-43 toxicity, a genetic screen identified 50 suppressors, including 15 RNA-binding proteins, with RPB7 emerging as the strongest. RPB7, a subunit of RNA polymerase II, supports transcription under stress conditions and may mitigate TDP-43 toxicity by stabilizing RNA metabolism and reducing stress granule persistence. This study aims to investigate how RPB7 modulates stress granule dynamics, structure, and components, hypothesizing that it counteracts TDP-43-induced stress granule phenotypes to restore cellular homeostasis.

106 Quantifying the Effects of Soil Nutrient Availability on Autonomous Root Foraging Under Increased Soil pH and P

Slaughter, Mariah; DeForest, Jared; Greene, Madeline; Walters, Leif; Barnett, Shania; Rúa, Megan

Mentor: Rúa, Megan

The ability of plants to grow and survive is directly linked to their ability to acquire nutrients from the soil. Acquisition may occur autonomously through tree root systems or through collaboration with mycorrhizal fungi in the soil. However, how they acquire nutrients from the soil may shift due to nutrient availability. To determine if nutrient availability increases autonomous acquisition, we explored how Acer trees shifted between autonomous and collaborative foraging with long-term manipulations of soil pH and phosphorus. Root tissue density decreased with phosphorus mineralization ($F_{1,159}=6.00$, $p=0.015$), indicating that investment into autonomous root traits are more common when nutrients are readily available. Exploring this tradeoff will increase our understanding of how shifts in soil nutrient availability affects foraging strategies of trees, which in turn may affect their survival and productivity.

107 Microplastics in Riverine Wetlands of West-Central Ohio

Steeves, Olivia Grace; Link, Mitchell; Hossler, Katie; Retherford, James Tyler
Mentor: Hossler, Katie

Riverine wetlands are a class of wetlands that form in riparian zones and floodplains along rivers and streams. Riverine wetlands play a critical role in flood control and provide a wide range of other ecological benefits. Due to some of their properties, riverine wetland soils are susceptible to the increasing threat of microplastic pollution. This project aims to create a larger understanding of the types and distributions of microplastics found in riverine wetland soils by examining fifteen riverine wetland sites. Five soil samples from each will be processed for microplastics by physical fragmentation, density separation, digestion, and microscope identification.

108 Assessing the Presence of kleptopharmacophagy in Danaus plexippus

Wagner, Richard Scot; Cipollini, Don
Mentor: Cipollini, Don

Butterflies in the Danainae have been observed consuming sap from withered plant material, with publications dating back to the 1980s, leading to the discovery of nuptial gift-giving of polyphenol alkaloids in these species. In 2021, an observation indicated a competing behavior, kleptopharmacophagy, entailing one organism stealing another's stored chemicals through cannibalism. This behavior was observed in just a few species of the Danainae subfamily, including Euploea algae, Ideopsis juventa, and Danaus ismare. These organisms are seen cutting open caterpillars to extract hemolymph with their proboscis. No published follow-up studies have been conducted to address the prevalence or implications of this behavior throughout the Danainae. The objectives of this preliminary investigation are to establish a methodology for identifying kleptopharmacophagy across different species and assess its potential occurrence in Danaus plexippus through field observations. We hypothesize that kleptopharmacophagy is a well-conserved behavior across the Danainae subfamily, with many members exhibiting it. Field sites were established based on physical observations of D. plexippus adults, larvae, or larval herbivory. Field sites were monitored weekly for signs of kleptopharmacophagy. Any sites that had injured or dead caterpillars from lacerations were documented as proposed incidents. Cameras were set up at sites with proposed incidents to capture direct evidence of the behavior. After 15 weeks, no larvae were observed, and four observations of adults were made. Drought conditions and atypical overwintering activity were proposed reasons for the lack of observations, indicating a need for further investigation.

Department of Chemistry

109 Heavy Metal Detection Utilizing an Electrochemical Sensor

Andoh, Papa Kofi Damte; Lunsford, Suzanne
Mentor: Lunsford, Suzanne

This research focuses on an electrochemical sensor to detect heavy metals. As part of the sensor fabrication process, nanoparticles are synthesized and used to enhance the detection capability of the electrochemical sensor. Nanoparticles synthesized include copper, silver and a bimetallic which is a combination of silver and copper. These nanoparticles are synthesized via two main methods, the green synthesis method which involves the use of clean, safe, cost-effective and environmentally friendly substances as well as alternate method which involves the use of laboratory reagents which may be carcinogenic. Once these nanoparticles are synthesized and characterized by methods such as UV-visible spectroscopy and Fourier Transform Infrared Spectroscopy (FTIR), their ability to enhance detection is studied in preliminary experiments. These experiments involved the use of electrochemical methods such as cyclic voltammetry and Square-wave anodic stripping voltammetry to detect heavy metals such as lead, cadmium, chromium and monitor how selective these nanoparticles are towards specific heavy metals. Regression analysis was performed to study how these sensors are likely to perform at various concentrations of these heavy metals. The detection was performed on samples containing heavy metals in very trace amounts, that is in ppb and ppm concentrations. Furthermore, the sensor was tested on drinking water samples and results obtained were compared to results obtained from traditional ICP-OES detection of heavy metals.

110 Investigations of Pre- and Post-nucleation Solution Chemistry Through Ion-selective Electrode Potentiometric Titrations

Hunt, Caroline M; Asare, Abigail Akosua Serwa
Mentor: Higgins, Steven

The initial formation of crystals from supersaturated solutions has long been described by classical nucleation theory (CNT) which predicts that crystal nucleus formation is a very rare event brought about by statistical fluctuations in the solution. A more recent model, considering the formation of prenucleation clusters (PNCs) considers the presence of thermodynamically stable ion clusters that form in solutions prior to nucleation of crystals, and even in solutions that are undersaturated with respect to all solid phases. In the present research, ion-selective electrode potentiometric titrations were conducted in the study of calcium fluoride crystal nucleation to identify evidence in support of CNT or the PNC model. Prior results in our lab suggest that during the titrations, equilibrium is not established as rapidly as has been assumed by previous studies on calcium carbonate. The implications, if these observations are corroborated in our current studies, could cast doubt on the viability of the PNC model.

Department of Computer Science and Engineering

111 EngagementTracker: Monitoring Mental Engagement Through Fatigue and Biometric Changes

Whorton, Ameila; Banerjee, Tanvi; Romine, William; Myers, Tiffany; Stevens, Christopher; Morris, Megan; D'Amour, James; Behr, Joseph; Fauley, Timothy

Mentor: Banerjee, Tanvi

Cognitive flow is a mental state of being completely engaged in an activity. Experiencing flow has been shown to improve learning and skill acquisition. Traditionally, survey and experience sampling methods have been used to track flow. We have developed a software application for tracking flow for the Garmin smartwatch. By capturing biometric data and questionnaire data during learning tasks, We will gain knowledge about the relationships between Cognitive state and biometrics. With this insight, we will construct models for flow derived from the physiological fluctuations seen during flow states. Exploring these indicators within and across individuals will determine the efficacy of our models.

Department of Neuroscience, Cell Biology, and Physiology

112 Elevated Levels of Circulating Extracellular Vesicles Inhibit Angiogenesis in Severe Early-Onset Preeclampsia

Bowman-Gibson, Scout; Rackett, Traci M.; Attikple, Tracy I.; DeRespiris, Hannah M.; Lowell, Josie M.; Wilcher, Katherine E.; Maxwell, Rose A.; Dhanraj, David N.; Brown, Thomas L.
Mentor: Brown, Thomas L.

Preeclampsia is a common pregnancy-associated disorder and a leading cause of maternal and fetal morbidity and mortality. Circulating levels of extracellular vesicles (EVs) are significantly elevated in patients with severe early-onset preeclampsia (sEOPE); however, it is not known how EVs contribute to the pathophysiology. To address this question, we evaluated the functional activity of EVs on cell migration and angiogenesis in human umbilical vein endothelial cells. Our results indicate that plasma-derived maternal EVs from sEOPE patients significantly inhibit cell migration and angiogenesis, compared to normotensive controls, and suggests that EVs may be an important mediator in the pathogenesis of this condition.

113 Decoding Ion Channel Phosphorylation: A Novel Approach to Kv2.1 Expression in Spinal Motoneurons

Chattopadhyay, Kalyani Marie; Highlander, Morgan; LeHoty, Bradley; Busick, Grace
Mentor: Elbasiouny, Sherif M.

Kv2.1 is a sophisticated regulator of motoneuron repetitive firing, playing both conductive and structural roles during motoneuron activity. We seek to link the structural expression of the Kv2.1 channel to its functional states by (1) pharmacologically inducing its extreme states of phosphorylation and (2) implementing our novel and rigorous algorithmic 3D analysis to determine the parameters that best characterize Kv2.1's range of expression. Using glutamate to activate Kv2.1 and stromatoxin to inhibit Kv2.1, we expect there to be identifiable measures sensitive to changes in Kv2.1 phosphorylation. This calibration study redefines how we measure phosphorylation and sets the stage to link channel function to structure and membrane expression with high sensitivity and utmost rigor.

114 Investigating the Role of PERK in Type 2 Diabetes Associated Cognitive Impairment

Chisholm, Amanda; Shelby, Jennae; Sheriff,Nathan; Akhmedov, Islam; Susuki, Keiichiro
Mentor: Susuki, Keiichiro.

Type 2 diabetes is highly associated with cognitive impairment. We seek to elucidate the underlying mechanisms by focusing on the neuron's axon initial segment (AIS). This specialized region at the beginning of the axon produces action potentials. Even subtle shortening of the AIS length has been shown to decrease neuronal excitability. AIS length is shorter in type 2 diabetic mice with cognitive impairment, although the mechanism remains unknown. Endoplasmic reticulum (ER) stress and subsequent unfolded protein response (UPR) have been implicated in the pathophysiology of diabetic brain complications. Of the three UPR pathways, PERK has been most strongly linked to neurodegenerative conditions with cognitive impairment. To test the hypothesis that the PERK pathway mediates AIS shortening, we treated mouse cortical neuron cultures for up to 24 hours with tunicamycin, a known ER stress inducer. We recorded neuronal network activity by multi-electrode arrays, and measured AIS structural changes by immunofluorescence. Here we show that ER stress induction decreases neuronal network activity and shortens the AIS length. Additionally, co-treatment with PERK-specific inhibitor GSK2606414 prevents this ER stress-induced AIS shortening. Our results identify PERK as a potential target for treatment of type 2 diabetes associated cognitive impairment.

115 Sustained Peripheral Nerve Injury in Military Relevant Operational Environment: Role of Mitochondrial Function

Grant, Delaney Christine
Mentor: Ladle, David

Combat-sustained peripheral nerve injuries (PNIs) are often the result of high-energy blast mechanisms and lead to impaired sensation and motor function. PNIs encompass a variety of injuries with various severities; however, they all share similar inflammatory, pathophysiological, and degenerative responses. The cellular responses to PNI and how they contribute to (or limit) recovery in sensory neurons remain unknown; however, mitochondria dysfunction has been observed in several other peripheral neuropathies. We aim to understand the role mitochondria play in responding to PNI, specifically crush and transection injuries. Cell types in the dorsal root ganglion (DRG) include both sensory neurons and satellite glial cells (SGCs), that are tightly associated with DRG neurons and influence neuron function, as well as balance ATP and Ca2+ levels in the DRG. Therefore, a comprehensive study of mitochondrial changes after PNI should include analysis of both sensory neurons and SGCs. Our analysis of mitochondria in SGCs and neuronal cells show altered mitochondria count and morphology after sciatic nerve crush and sciatic nerve transection injury. Preliminary results show that these changes appear to be time-point-dependent after injury and depend on the type and severity of injury. Understanding changes in mitochondria morphology after PNI can shed light on the basic metabolic capacity of cells after injury and how this may be limiting to recovery. Such information is critical to develop improved treatments for those with PNIs.

116 Altered Resting ASL-MRI Perfusion in a Cohort of Qualified Veterans and First Responders Suffering with PTSD Symptoms: A MRI Pilot Study

Hildreth, Megan; Pyle, Kelsie; Sherwood, Matthew

Mentor: Sherwood, Matthew

Military veterans and first responders experience higher rates of post-traumatic stress disorder (PTSD) than the general population. Despite being recognized in the DSM-III, existing pharmacological and psychotherapeutic treatments often produce artificial results and fail to address the underlying mechanisms of PTSD. Understanding these complexities could dramatically improve prognosis and treatment outcomes. This study presents findings from a substudy within a larger project evaluating the safety and efficacy of encephalography transcranial magnetic stimulation (eTMS) as a treatment for PTSD. We utilized pseudo-continuous arterial spin labeling, a non-invasive MRI technique, to evaluate resting cerebral perfusion as a potential biomarker. Resting cerebral perfusion was assessed preceding and after the application of the 20-treatment, open-label eTMS protocol. To further investigate cerebral perfusion in PTSD, pre-treatment perfusion was compared to a healthy control group. The relationship between changes in PTSD Checklist for DSM-V (PCL-5) scores and changes in perfusion were evaluated to examine the effects of perfusion on the manifestations of PTSD. In the individuals with PTSD, pre-treatment perfusion was significantly lower in the left amygdala and hippocampus but increased significantly following treatment. Additionally, PCL-5 scores negatively correlated with perfusion in these cortical regions highlighting their role in PTSD pathology. As perfusion reflects metabolic demand, these findings suggest further implications on what could be occurring at a cellular level. Understanding metabolic markers of this disease can give valuable insight into the efficacy of novel treatments or to distinguish perfusion biomarkers of PTSD as a diagnostic tool.

117 Assessment of MRI Measurement Stability of Philips Health dStream Achieva 3T Scanner

Jaber, Raneen; Pyle, Kelsie
Mentor: Sherwood, Matthew

Measurements from magnetic resonance imaging (MRI) are critical foundations to research. Research applications anticipate longitudinal stability in such measurements. Researchers will often establish normative data sets for MRI systems. The current study's main objective is to evaluate the stability of measurements from structural MRI sequences utilizing a 3T Philips scanner. This study included healthy students from WSU's Dayton campus. It was hypothesized that cortical thickness will remain unchanged across each acquisition. To accurately depict these critical measurements, specific post-processing software has shown limitations. A thorough comparison of software's segmented regions is to be conducted to precisely depict true measurement stability.

118 C-Fiber Hyperexcitability After Acute Compression in Sciatic Nerve

McNeil, Arian K; Rich, Mark; Ladle, David
Mentor: Ladle, David

Neuropathic pain (NP) can be a debilitating concern for patients with a variety of underlying pathologies. From post-surgical pain to diabetic and chemotherapy-induced neuropathies, to postherpetic neuralgia, NP can have a major impact on quality of life on timescales of weeks to years. Radicular pain, the pain caused by nerve stretch and compression as a result of either bulging or herniated intervertebral discs, is another subset of NP. Unlike most other sources of NP, radicular pain can have a rapid onset. Herniating disc events can lead to disabling pain within minutes, with painful symptoms typically lasting 10-12 weeks. Disappointingly, first-line drug treatments for NP, including the gabapentinoids and tricyclic antidepressants, are largely ineffective for radicular pain, suggesting important mechanistic differences from other types of NP. The rapid onset of radicular pain suggests early changes in the function of peripheral nerves—the site of the local injury in disc herniations—may be an overlooked mechanistic contributor to this kind of pain. In order to investigate the earliest changes in peripheral nerves following nerve compression, we have developed an ex vivo model of radicular pain that measures the response of pain fibers in the sciatic nerve to acute and controlled compression of the nerve in adult mice. We have preliminary data that shows an increase in C-fiber responses, the axons that convey signals about tissue damage and other painful events to the central nervous system through peripheral nerves like the sciatic nerve, for at least 60 minutes following a 10-minute nerve crush. We hypothesize and have preliminary data that the elevated activity in these nerves is the result of persistently active Na+ currents in the nerve that drives repetitive firing at the site of damage.

123 Age-Related Structural Changes in C-Boutons: Unveiling Sex and Motor Neuron Type-Specific Differences

Ward, Shelby; Ghouse, Zuhair; Highlander, Morgan; Garrett, Teresa; Elbasiouny, Sherif
Mentor: Elbasiouny, Sherif

More than 40% of older adults (65 years or older) have functional limitations affecting their essential daily tasks. Age-related weakness has previously been attributed to muscle atrophy however it has been well established that muscle mass and strength do not directly correlate. While muscular atrophy has been ruled out as a sole contributor to age-related loss of muscular strength, motor neuron (MN) involvement is still unclear. MNs innervate skeletal muscle and are composed of four types that contribute to different activities: fast-twitch fatigable (FF), fast-twitch fatigue-intermediate (FI), fast-twitch fatigue-resistant (FR), and slow-twitch (S). MNs experience hypoexcitability with age warranting investigation of the C-Bouton, an excitable input to MNs. For the first time, immunohistochemistry was used to label all four MN types in both male and female mouse lumbar spinal cord at young (3-4 months), middle-aged (13-14 months), and old (24-29 months) timepoints. Novel automated analysis was used to collect 2D and 3D C-Bouton measurements. The results show differing mechanisms of reduced C-Bouton input with age in males and females through size and number, respectively. However, a reduction in total C-Bouton input with age was noted in females only. Additionally, the FF, FI, and S MNs were proven to be the MN types underlying the reduction in total C-Bouton input. This suggests that C-Boutons synapsing FF, FI, and S MNs contribute to age-related weakness and that C-Boutons are a contributor to age-related weakness in females.

124 Applying Different Quantitative Techniques to Determine Underlying Biological Effect on Miniature Excitatory Postsynaptic Currents Recorded in Whole-Cell Voltage Clamping

Whitlock, Eva M; Engisch, Kathy
Mentor: Engisch, Kathy

Miniature excitatory postsynaptic currents (mEPSCs) are small currents caused by the random release of single synaptic vesicles. They represent the smallest unit of synaptic communication and are recorded using whole-cell voltage clamping, a technique that holds the membrane voltage constant to measure current flow across the cell membrane. Applying quantitative techniques to determine how experimental manipulation affects mEPSCs is crucial to understanding the role of synaptic transmission in normal and pathological states. To evaluate efficacy of quantitative methods, we can leverage Ohm's Law (V=IR) to induce a known, homogeneous shift in current amplitudes through controlling the holding potential. First, are recorded mEPSCs at –60mV (close to cell's resting potential) for 3 minutes, then mEPSCs recorded from the same call at –40mV for 3 minutes. The expectation is that there will be a uniform reduction across all amplitudes. Then we can examine how applying different quantitative techniques effectively capture and present these results. We employ quantification techniques, including frequency histogram, ratio plot, rank-order plot, and an iterative method. Frequency histograms outline amplitude distributions under both conditions. Ratio plots present the ratio of experimental and control amplitudes in descending size order. Rank-order plots compare individual amplitudes from control versus amplitudes in experimental conditions, the slope of the best fit line representing proportionality of change. Additionally, we apply an iterative method that systematically adjusts amplitudes by applying arbitrary scaling factors and using the Kolmogorov-Smirnov test to determine if the conditions have a similar distribution. Each of these methods provides insights into the homogeneous effect. Collectively, these analyses reinforce the importance of using diverse quantitative approaches to assess biological changes in electrophysiological recordings. By comparing these methods, we highlight their relative advantages and limitations, offering a framework for future studies seeking to characterize synaptic alterations due to pathological states in whole-cell voltage clamp experiments.

Department of Pharmacology and Toxicology

125 Influence of Xenobiotics and Hormonal stressors on Antibody Production

Arora, Harleen Kaur; Gautam, Sonika; Rachakonda, Venkata Sailaja; Bhakta-Yadav, Mili; Sulentic, Courtney

Mentor: Sulentic, Courtney

The immunoglobulin heavy chain gene (IgH) undergoes large-scale alterations to express a diverse antibody repertoire, with each antibody isotype having different effector functions in regulating immune function. The transcription of the human IgH gene is regulated by two identical 3'IgH regulatory regions (3'IgHRR) that lie downstream of the IgH constant domains. Each 3'IgHRR contains the three enhancer regions hs3, hs1.2, and hs4. These enhancers contain putative binding sites for a number of transcription factors that may be modulated by environmental stressors. Also, hormonal stressors (such as estrogen, β-adrenergic receptor agonists) have a significant influence on several signaling pathways, which may modulate the 3'IgHRR activity and hence, antibody production. However, these findings are based on non-human models, which represents a significant gap in our understanding of antibody production in humans. This research study will focus on evaluating the effects of a hormonal stressor (cortisol) with/without the combination of a β-adrenergic receptor agonist (terbutaline) on the isotypic expression profile in CRISPR-Cas9 edited variants of a human B-cell line. These variants differ in their hs1.2 enhancer genotype that has a significant association with serum antibody levels and autoimmune disorders. We hypothesize that genetic variations in the 3'IgHRR (i.e. hs1.2 enhancer) will influence the sensitivity for altered antibody production in response to xenobiotics and endogenous stressors.

126 The Role of AhR in Human Antibody Production

Lowe, Addison; Bhakta-Yadav, Mili; Sulentic, Courtney
Mentor: Sulentic, Courtney

The aryl hydrocarbon receptor (AhR) is known for mediating biological effects of various environmental toxicants. 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) is a high affinity AhR ligand widely known to inhibit antibody production in B lymphocytes. Using a human B lymphocyte cell line, SKW 6.4 cells, which does not endogenously express the AhR, and a variant of the cell line that has been modified to express the AhR (SKW AhR+), we will evaluate the role of the AhR in TCDD-induced inhibition of antibody production. The potential impact of different B-cell stimuli on the effects of TCDD will also be evaluated. Understanding the role of the AhR in human antibody production will directly impact assessing risk of exposure to a variety of AhR ligands.

Department of Physics

127 Particle-in-Cell Simulations to Study the Propagation of Electromagnetic Waves in Plasma

Sager, Aya
Mentor: Sharma, Amit

This study uses a numerical approach to investigate the propagation of electromagnetic (EM) waves in plasma. We begin by developing a one-dimensional (1D) electrostatic particle-in-cell (PIC) code and validate its accuracy through the well-known two-stream instability, serving as a benchmark for our implementation. Building upon this foundation, we extend our work to a two-dimensional (2D) electromagnetic PIC code, leveraging insights gained from the 1D simulations. The 2D Kempo code is then used with change in the diagnostic tools to align with the specific objectives of our research to examine EM wave propagation in plasma under three distinct conditions: (1) unmagnetized plasma, (2) magnetized plasma, and (3) magnetized plasma with an inhomogeneous density profile.

Department of Psychology

128 The Impact of Ecologically Relevant and Irrelevant Stimuli on Groups of Earthworms in an Open-Field Environment

Allen, Angela; Herb, Lydia; Peters, Avaleigh; Claflin, Dragana
Mentor: Claflin, Dragana

This study examined the effect of social groups on fear-related freezing behavior in earthworms (Eisenia fetida). Earthworms were placed in groups of 1, 3 or 5 in an open field environment and presented with predatory sounds (grunting or mole) for 14 seconds. Although there were no coordinated group responses to the stimuli, less freezing was observed when the worms were in groups, especially for the grunting sound. Freezing was the predominant response of individuals to grunting, but no clear behavior was observed for the mole sound. This study provides a foundation for future research into social influences on earthworm behaviors.

129 Aggressive and Affiliative Behavior During Eating in Intact vs Neutered Feral Cat (Felis catus) Colonies

Arnold, Chelsea Lee; Kraszpulski, Michal
Mentor: Kraszpulski, Michal

Feral cats can be described best by their lack of socialization and varying degrees of aggression and social interactions with other cats. Trap, Neuter and Return (TNR) programs are designed to help control and maintain a feral cat population, allowing the feral cats to continue living without increasing the population. TNR programs have several benefits like population stabilization and increasing the number of cats vaccinated from diseases such as rabies. Sterilized cats are less likely to make noise, such as calls to warn off or attract other cats that disturb the community surrounding them. They are generally healthier because they are not expending energy on caring for offspring nor engage in frequent fights. This study explored the impact sterilization has on aggressive and affiliative behaviors of feral female cats. Two cats' colonies were observed, one consisting of released neutered animals and the other comprising unaltered ones. Observations were conducted during morning and evening feeding times. Analysis of the frequency of aggressive and affiliative behavior showed a significant increase just before feeding time in both colonies, however, differences in aggressive behavior were only significant during evening feeding times. These behavioral differences were not related to the time of day but to unaltered/neutered condition of cats. This could suggest that sterilization may increase the likelihood of social interactions and potential to engage in affiliative behavior in the absence of food. Food prioritization can be directly impacted by reproductive pressures such as pregnancy and providing for offspring and sterilized cats are released from these demands, decreasing instances of aggressive behavior around food. This result further supports the idea that TNR programs promote healthier lives and support affiliative social interactions between feral cat populations.

130 Moderating Role of Valence on Organizational Constraints and Employee Outcomes

Bommareddy, Sruthi; Steele-Johnson, Debra; Tangeman, Andrew; Davis, Bincy
Mentor: Steele-Johnson, Debra

Organizational constraints negatively impact employee outcomes, such as performance and job satisfaction (Gilboa et al., 2008; Pindek & Spector, 2016). However, the role of valence of Expectancy Theory (Vroom, 1964) remains underexplored. This study examines valence as a moderator, proposing that high valence can mitigate or exacerbate the effects of constraints. By understanding how the perceived importance of outcomes influences responses to constraints, this research provides new insights into the variability of constraint-related outcomes.

131 Exploring Time-On-Task Mechanisms Across Three Naturalistic Tasks

Carson, Jarean; Menke, Preston; Wong, Joshua; Nasirabadi, Afra Moharrami; Juvina, Ion; Watamaniuk, Scott; Davis, Tehran; Aue, William; MacNeil, Emma

Mentor: Juvina, Ion

Many tasks require sustained attention and result in unwanted consequences when vigilance suffers. For example, baggage screeners must remain vigilant when watching for potential threats amidst many benign objects (Meuter & Lacherez, 2016). Similarly, air traffic controllers, radar operators, and pilots of both manned and unmanned aerial vehicles must remain vigilant when scanning indicators or monitoring and controlling events (Mouloua, Gilson, Kring, & Hancock, 2001). Vigilance is usually assumed to suffer due to mental fatigue, resulting in performance decrements, such as increased errors and longer reaction time (Warm, Finomore, Vidulich, & Funke, 2015). Mental fatigue due to time on task may result in an increased cognitive load, reducing the resources available for the task with a corresponding performance decrement. Thus, a common theory holds that mental fatigue is the result of depletion of resources (Grier, et al., 2003). However, some propose that the performance decrement is due to mind wandering (Zanesco, Denkova, Barry, & Jha, 2024), a shift in strategy (Jongman & Taatgen, 2020), or a proactive shift in behavior to conserve resources (Rubinstein, 2020). Preliminary analysis of data from 44 participants performing three decision-making tasks related to target verification, strategic decisions, and image recognition in three consecutive days found evidence of a vigilance decrement. However, the expected decrement was accompanied by unexpected performance improvements in other measures. We propose that this surprising combination of performance decrement and performance improvement is due to a complex combination of memory decay, interference, and strategic learning. Such cognitive mechanisms have important implications for real-world tasks. For example, if a vigilance decrement is due to mental fatigue, more breaks or shorter shifts would be appropriate. However, if the observed performance decrement is due to strategic learning, a shift in the training approach may be more appropriate. Understanding cognitive mechanisms provides guidance for effective interventions.

132 Autism and Alpha Waves

Harris, Fin; Schiml, Patricia
Mentor: Schiml, Patricia

The rates of autism spectrum disorder have more than doubled in the past decade alone (Hirota, et al., 2023). Autism greatly varies in its presentation from child to child and this makes formulating a scale for its diagnosis and treatment incredibly challenging. Currently existing tools rely heavily on the observations of a child's guardians and diagnostic team which may lead to unfortunate biases when trying to get a child the help they need. The measurement of peak alpha frequency has been historically used when comparing normal brain activity to abnormal activity and can provide researchers with an objective measurement of neural activity. This literature review will examine the utility of using peak alpha frequency as a measure of autism spectrum disorders.

133 Diverse Environments: Reviewing and Refining the Concept of Remote Work

Schwanz, Riley; Steele-Johnson, Debra; Davis, Bincy; Tangemen, Andrew
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Remote work technology and adoption has spread exponentially on a global scale over recent decades. Researchers have attempted to address important questions such as whether, how, and, why in-person work environments differ from remote work environments. Our review of the remote work literature raised issues and gaps relating to a lack of consistent definitions, taxonomies with theoretical underpinnings, application of well-established theories, and consistent results. We discussed these issues and proposed a conceptual 're-thinking' for how to approach and study remote work environments.

134 A Systematic Study of Freezing Behavior in Earthworms in Response to Auditory and Vibratory Stimuli

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Mentor: Claflin, Dragana

This study examined the parameters needed to reliably induce a fear-related freezing response to a predator-like auditory stimulus (grunting) in the earthworm species Eisenia fetida. The sound was presented at varying amplitudes in both serial and random sequences, while also assessing the effect of contact vibration from the speaker. Results indicate that contact vibration contributed to a higher rate of freezing compared to sound waves alone. Our study provides evidence for the importance of physical vibration in the recognition of threats in the earthworm environment.

135 Turnover Intention: Intention to Stay versus Intention to Leave

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Mentor: Steele-Johnson, Debra

High turnover rates can have severe negative impacts on a company, such as decreased work productivity, decreased job satisfaction of employees, and significant financial costs to the organization. Turnover intention has emerged as a key predictor of turnover behavior. Nearly all researchers investigating turnover intention have treated intention to stay and intention to leave as the same construct. However, recent research has suggested that intention to stay and intention to leave might capture different but related constructs. The purpose of this paper is to use Conservation of Resource Theory as a lens through which to examine potential differences between intention to stay and intention to leave.

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136 Comparative Analysis of Total Knee Arthroplasty Data from the Swedish National Registry

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Total Knee Arthroplasty (TKA) is a widely performed orthopedic procedure aimed at alleviating pain and improving mobility in patients with severe knee osteoarthritis. National collaborative registers are essential for tracking results, spotting patterns, and raising standards of care. Focusing on patient demographics, implant survival rates, revision risks, and clinical outcomes during a specified time, this study compares TKA data from the Swedish National Knee Arthroplasty Registry (SNKAR). The investigation looks at differences in surgical methods, perioperative management plans, fixation methods, and implant types. Complication rates, comorbidities, functional scores, sex distribution, and patient age are important factors. In conclusion, this comparative analysis provides valuable insights into the evolving trends in TKA, emphasizing the role of national registries in improving surgical outcomes. Continuous monitoring, data-driven innovations, and adherence to best practices remain crucial in optimizing patient care. Future research should focus on further refining patient selection criteria, enhancing implant designs, and integrating artificial intelligence for predictive analytics in TKA planning and postoperative assessment.

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