WRIGHT STATE UNIVERSITY

2023 Celebration of Undergraduate & Graduate Research, Scholarship, & Creative Activities

October 26, 2023

Wright State University Student Union

SCHEDULE OF EVENTS

Wright State University Student Union

8:30 a.m.	Registration/Check-in	Skylight Lobby
	Set Up • Posters • Sponsors • Colleges/Schools and Core Facilities	Apollo Room
9:00 a.m.	Celebration Begins • Opening Remarks – Amy Thompson, Provost and Senior Vice President Academic Affairs • Welcome – Madhavi Kadakia, Vice Provost for Research and Innovation • Presentation Sponsor – Bob Sherwood, Ball Aerospace, Director, Advanced Technology & Information Solutions • Technology Transfer – Julie Nagel, Office of Technology Transfer Consultant	Endeavour Room
9:45 a.m.	Plenary Speakers • Ume Adaku – Friend or Foe: The role of the TGF-beta receptor in calcineurin inhibitor-induced renal damage. (BSOM) • Sifat Mahmud – Connecting with Consumers Can Lead Successful Business in Retail Banking (RSCoB) • Lucas Clark – Direct Ink Write Processing of Signal Crossovers Using Aerosol Jet Printing Method (CECS) • Nainika Hira – My Experiences with Research at Wright State: As an International Student of Clinical Mental Health Counseling (CHEHS) • Kelia McMichael – The Renal Epithelial Sodium Channel Mediates Zinc Deficiency-Induced High Blood Pressure (COSM) • Cayden Whitman – The Champaign Lady - Preserving the History of the B-17 Bomber (COLA)	

11:15 a.m.	Data Blitz Session • Akshay Hira – TIP60 Mediated Regulation of ΔNp63α is Associated with Cisplatin Resistance (COSM) Poster #22 • William Cvammen – Pharmacological Manipulation of the Circadian Clock Protects Human Keratinocytes from UVB Exposure (BSOM) Poster #14 • Lemuel Duncan – Mechanical Reliability of Strain Sensors Printed Using Additive/Subtracted Hybrid Fabrication Method (CECS) Poster #66 • Angela Bingaya – A Winning Effort: What prepares Public Administration students to enter Local Government? (COLA) Poster #75 • Anthony Milard Young – Exploring the Impact of Reduced Cardiomyocyte Complex/Hybrid N-Glycosylation on Heart Failure Progression (COSM) Poster #108 • Courtney Breann Johnson-Gonzalez – Master Regulators of Oxygen Sensing and Cellular Energy in the Human Placenta are Significantly Associated with Early-onset Preeclampsia (BSOM) Poster #11 • Antrea Christou – Improving Knowledge Graph Understanding with Contextual Views (CECS) Poster #55 • Alexander Buchheit – Sport as Public History: My Time at the National Baseball Hall of Fame and Museum (COLA) Poster #74 • Holly Marie Johnson – Furosemide for Postpartum Management of Hypertensive Disorders: A Randomized Controlled Study (BSOM) Poster #10 • Austin Reed – Molecular Scale Highways for Protons: Poly(Arylene Ether)s with Pendant Sulfonic Acid Groups (COSM) Poster #94 • Akshay Charlise - Design and Analysis of Acrylic Resin Transfemoral Sockets for Improved Lower Limb Prostheses (CECS) Poster #34	
12:15 p.m.	Lunch	Atrium
	Invite Guests	Wright Bros. Room
1:15 p.m.	Poster Session	Apollo Room
4:00 p.m.	Conclusion	

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Boonshoft School of Medicine

Dermatology

1 The Potential Uses of Fish Oil in Wound Healing: A Review

Chong, Christian Taewon; Nguyen, Trang; Wu, Kevin; Giger, Dasha; Daveluy, Steven
Mentor: Daveluy, Steven

The skin protects against environmental injury and, when harmed, triggers the wound-healing process. Fatty acids found within fish oil have been found to modulate the immune response, angiogenesis, and cellular proliferation, showing potential for use in cutaneous wounds.1 Previous studies have shown inconsistent effects of fish oil, with some studies reporting enhancement while others reporting inhibition of healing. Despite ongoing research on fish oil, there has been limited examination of the combined results of individual studies. Articles were found through PubMed and the Wright State University Library using the terms “fish oil and cutaneous wounds,” “fish oil and cutaneous,” and “fish oil and wound healing” from 12/13/22 to 12/22/22. Articles from 2012-2022 were selected. Oral supplementation with fish oil led to delayed wound closure and decreased healed tissue quality in mice. Similarly, topical supplementation with fish oil also delayed wound closure; tissue quality was unaffected. Topical supplementation with fish oil derivatives resolvin D1, D2, and D4 resulted in faster wound closure. 14S,21-diHDHA, another derivative, improved vascularization in wounds. Mice genetically modified to endogenously produce omega fatty acids experienced longer healing times and lower tissue quality. Supplementation with fish oil resulted in impaired healing due to an increased inflammatory infiltrate and slowed resolution of the inflammatory phase of wound healing. Administration of the resolvins appears to aid in wound healing by targeting keratinocytes to promote re-epithelialization. Similarly, 14S,21-diHDHA specifically acts by promoting vascularization in wounds. The lack of specific fish oil formulations, inconsistency in reporting quantitative values, and the absence of a systematic review limit our conclusions. Fish oil supplementation appears to impair wound healing; however, derivatives of fish oil have promise in a therapeutic capacity, and more research should be conducted into these substances.

Family Medicine

2 Finding the Motivation for Exercise: Impact of Intervention and Goal Setting on Exercise

Carnes, Sydney Nicolle; Alslaiti, Yaman; Gladkly, Yevgenly; Westrick, Lexi; Yeager, Matt; Conway, Kate

Mentor: Conway, Kate

Obesity is a growing concern in local family practice offices. The percentage of adults that report a body mass index (BMI) >/= 30 kg/m2 is 35% for Greene County, compared with the national average of 32%. Recent studies have shown that most who lose weight with dieting gain weight back in 3-5 years, while regular exercise helps maintain weight and decrease cardiovascular morbidity and mortality. The primary objective of this study is to determine the impact of motivational interviewing (MI) versus MI combined with a prescription for exercise (ExRx) on minutes per week of exercise in patients with BMI >/= 30 kg/m2. Patients were either given MI alone, or MI and ExRx. A baseline of minutes per week exercised was established, and each patient was given either MI or MI and ExRx. An interview was done 7 days after in which exercise amount and adherence to the patient's goals was determined. After collection of data, a paired t-test was used for comparison of baseline data versus 7-day follow up exercise data for both MI and MI and ExRx, while an unpaired t-test was performed to compare MI versus MI and ExRx. We found that both the MI alone group and MI and ExRx groups had increases in minutes per week exercised, although not statistically significant. Interestingly, when comparing MI alone versus MI with ExRx, those who used ExRx had lower reported levels of enjoyment of exercise and self-reported adherence to goals, despite higher reported minutes per week, although both were not statistically significant. A potential contribution to lack of statistical significance could be overestimation of initial exercise, leading to an inaccurate comparison. For future studies, the patient could record their minutes per week of exercise for one week, and then continue the study as described previously.

3 A Multi-Method Approach for Evaluating Outreach Processes to Improve the Delivery of Colorectal Cancer Screening at a Large, Federally Qualified Health Center

Mike, Camari Genae; Dang, Tin H.
Mentor: Escaron, Anne

Background: Disparities in Colorectal cancer (CRC) screening are significant, particularly for underinsured individuals and ethnic minorities. Federally qualified health centers (FQHCs) provide care regardless of an individual's ability to pay and are thus positioned to address these disparities. Yet, CRC screening rates at FQHCs remain low relative to the national average. In light of this challenge, the processes by which FQHCs perform CRC screening outreach are important to consider, as outreach has been shown to improve screening rates. The purpose of this project was to conduct a process evaluation of CRC screening outreach workflows at an FQHC. Methods: In July 2023, semi-structured group interviews were conducted at two clinics affiliated with a large, FQHC based in Los Angeles, California. Interviews were audio-recorded and concurrently transcribed. Data from interview transcripts was visualized into process maps detailing outreach workflows and analyzed for themes following the six-phase thematic analysis process outlined by Braun and Clarke. The Consolidated Framework for Implementation Research (CFIR) was used to develop the interview questions and organize the findings from thematic analysis. Results: Six semi-structured interviews were conducted with a total of ten informants, which included clinic and quality improvement staff. Three swim lane process maps were generated, each lane detailing one of three centralized outreach workflows. Thematic analysis resulted in eleven themes organized into CFIR domains. Themes included: (1) Few communication channels between clinic staff and quality improvement team, (2) Rapid changes to outreach protocols resulting in unfamiliarity with centralized outreach workflows, (3) Lack of consensus over responsibility for conducting outreach. Conclusions: This study highlights the utility of conducting process evaluations to assess whether CRC screening outreach workflows function as intended. Future work should evaluate patients' preferences for clinic-based versus centralized outreach and explore whether implementing information technology infrastructure supportive of outreach has an effect on screening rates.

Internal Medicine

4 Retrospective Review: Automated Electronic Health Record Screening for Familial Hypercholesterolemia and Trends

Kalutskaya, Emilia Ilyichna; Bede, Kristen; Bazeley, Peter; Shah, Nishant; Cho, Leslie
Mentor: Tang, Wilson

Familial Hypercholesterolemia (FH), an autosomal dominant genetic disorder, confers increased risk for premature cardiovascular disease (CVD). Unfortunately, FH is often only diagnosed after a CVD event. The electronic health record (EHR) holds the potential to identify FH patients before an event occurs, but little is known about utilizing algorithms within the EHR. We seek to identify patients at-risk for FH through Dutch Lipid Clinic Network Scores (DLCNS) through EHR and examine them retrospectively to learn what percentage were diagnosed with FH. Of the patients we identified through the DLCNS and sorted into cohorts, we looked at long-term consequences by trending certain diagnoses, procedures, and medications. We reviewed the EHR of 2,122,563 patients from 20 to 60-years old seen at the Cleveland Clinic to identify 984 patients with premature CVD and laboratory LDL ≥ 190 mg/dL resulted between 2014 and 2019. Patients were identified using laboratory results, ICD-9 and 10 codes for premature CVD, physical exam findings, family history, prescribed medications, and genetic variant testing results. Patients were stratified into three separate DLCNS groups: 46 patients in Definite FH, 289 classified as Probable FH and 649 categorized as Possible FH. We found the formal diagnoses of FH for all cohorts was only 1.2%. Following trends from 2014-2022, all cohorts had a decrease in average LDL levels and coronary artery bypass grafts and percutaneous coronary interventions. All cohorts had an upward trend for coronary artery disease and preventative prescriptions like aspirin, statins, PSCK9 inhibitors, and ezetimibe.

5 Mycobacterium bovis Reactivation: A Bladder Backfire

Kleppel, Hilary Brooke; Herman, David; Booher, Katelyn
Mentor: Booher, Katelyn

Introduction: The Bacillus Calmette-Guérin (BCG) vaccine has been used for over 45 years in the clinical treatment of non-muscle invasive bladder cancer (NMIBC) as there is a rare rate of adverse effects. Case Presentation: A 78-year-old Caucasian male with a history of NMIBC initially treated January 2020 was admitted March 2021 with a three-month history of lower back pain. He endorsed night sweats and a 10 kg unintentional weight loss. Treatment history for NMIBC included transurethral resection of bladder tumor January 2020 and intravesical BCG April 2020 through August 2020. MRI of the lumbar spine exhibited L1-L2 discitis versus osteomyelitis with bilateral psoas muscle abscesses with marked progression from previous imaging studies. Acid-Fast Bacilli smear from the lumbar abscess aspirate resulted positive. Empiric M. bovis therapy was started and continued upon discharge. DNA probe for M. tuberculosis was positive. M. bovis grew from AFB culture at day 15 of incubation. In May 2021, he presented to outside hospital with weakness and back pain. He was found to have T12-L1 cord compression and pathologic fractures of T11, L1 vertebra. At that time, he underwent T12-L1 laminectomy, facetectomy, and partial excision of thoracolumbar epidural abscess, extradural intraspinal mass, T9-L4 fusion with screw rod placement, and reduction of T12-L1. Discussion: It is reported that vertebral osteomyelitis and spondylodiscitis secondary to BCG immunization occurs in less than 37 per 100,000 cases (1). In 2018, only 23 cases of vertebral osteomyelitis secondary to intravesical BCG were reported in English literature (1). This case illustrates challenges in making timely and accurate diagnosis in atypical mycobacterial infection. Conclusions: The goal of this case is to increase provider awareness regarding intravesical BCG therapy risk for M. bovis reactivation with potential to cause osteomyelitis, discitis, and abscess in the lumbar and/or thoracic spine.

6 Vanishing Bile Duct Syndrome in the Setting of Valproic Acid Use

Kleppel, Hilary Brooke; Dhiman, Akshima; Currey, Erin; Akrim, Aamir; Khan, Tahir;
Mentor: Khan, Tahir

Introduction: Vanishing Bile Duct Syndrome (VBDS) is an uncommon, severe form of chronic liver disease with loss of intrahepatic bile ducts (5). VBDS has been associated with drugs, herbs, supplements, infectious diseases, and immune-mediated reactions (2, 5). Case Description: A 64-year-old Caucasian male was admitted in the setting of acute onset jaundice with bilateral flank pain and Cola-colored urine. Significant medical history included bipolar disorder managed with divalproex sodium. Physical exam was remarkable for scleral icterus. Laboratory studies showed total bilirubin of 6.3 mg/dL; direct bilirubin of 5.1 mg/dL, indirect bilirubin of 1.2 mg/dL; alkaline phosphatase 674 U/L; AST 189 U/L; and ALT 170 U/L. Anti-smooth muscle antibody resulted weakly positive at 29 EIA but alpha-1 antitrypsin was within normal limits and antimitochondrial antibody was negative. Imaging revealed a mildly dilated common bile duct measuring 8 mm, unchanged from previous imaging. Biopsy was remarkable for cholestasis with ductular reaction, though without signs of a chronic process or significant destruction of intrahepatic bile ducts. There was concern for chronic exposure to a hepatotoxic drug, as the patient had taken divalproex sodium for 10+ years. The medication was discontinued, yet liver function tests continued to show uptrending bilirubin. Discussion: VBDS is associated with multiple medication classes, including antibiotics, anti-hypertensive medications, and anti-seizure medications, including divalproex sodium (5, 6). Typically, medication induced injury occurs within six months of initiating a new medication (8). This case is concerning for an atypical presentation of VBDS. Labs and imaging are consistent with the diagnosis, and biopsy was suggestive, though not definitive. Additionally, divalproex acid is an uncommon cause of VBDS. In this case, it is thought that an unidentified environmental trigger altered medication clearance and/or hepatic function, leading to bile duct injury. Notably, patient's symptoms improved with discontinuation of divalproex sodium.

Medical Education

7 Med School Made Easy: Piloting an Undergraduate Mentorship Conference

Ji, Katherine; Brahmandam, Sreya; Nepal, Hari;
Mentor: Nepal, Hari

Mentorship is a collaborative and supportive relationship where knowledge and firsthand experience can be passed on. Research has shown that 59% of medical students felt that they did not have enough mentorship prior to medical school. To help bridge this gap, a framework mentorship conference was developed to assist premedical students in the early parts of application to medical school. Current medical students were recruited from the Boonshoft School of Medicine AMSA chapter to formalize their experiential knowledge related to medical school applications. Pre-medical students across the US were invited to attend talks of their choosing and submitted questions to current students and admissions counselors. Following the conference, a summary document was provided to attendees and an optional feedback survey was administered. The conference had 142 participants from many different universities across the US. The feedback survey showed 70% of participants were extremely likely to recommend the event to a friend or colleague, had a very positive/positive rating of MSME, and felt better prepared on being a competitive medical school applicant. 60% of participants felt that this workshop will contribute to their academic and professional success. By covering broad topics and having speakers from different application backgrounds, we were able to engage a wide range of students. Based on the feedback, in the future we would like to increase length of dates, incorporate buffer time for better organization, have speakers pre-record information, have students submit questions prior to session to ensure we cover the most common concerns. Our hope is that by thoroughly documenting the development of this program, it can serve as a template for other medical schools to provide a similar opportunity for premedical students in their area.

Neurology

8 Evaluate Value of Pre-Alerting on Door-to-Imaging and Door-to-Needle Times in Stroke Patients with Large Vessel Occlusion

Carnes, Sydney Nicolle; Terry, John; Reynolds, Shelly
Mentor: Terry, John

Stroke is a leading cause of chronic disability in America, however it has been shown that stroke patients have decreased morbidity and mortality when reperfusion is achieved rapidly. This study evaluates the effect of pre-alerting prior to arrival at the ED on door-to-needle times and door-to-imaging times. Patient charts with stroke were examined retrospectively to collect data on EMS pre-alert, door-to-needle times and door-to-imaging times. The data was analyzed using an unpaired T-test. A statistically significant difference was found between door-to-needle times in patients that received pre-alert versus no pre-alert. There was no statistically significant difference found between door-to-imaging times in patients that received pre-alert vs no pre-alert. The mean door-to-needle time without pre-alert was found to be 180.25 minutes, and the mean door-to-imaging time was found to be 29.91 minutes. The mean door-to-needle time for those that received pre-alert was found to be significantly less at 92.95 minutes, and the mean door-to-imaging times was found to be less, however not statistically significant, at 15.86 minutes. The statistically significant decrease seen in door-to-needle times for pre-alerted patients with large vessel occlusion suggests a correlative relationship between lower overall door-to-needle times with increased EMS pre-alerting. Because of the known significance of lower door-to-needle times on improved outcomes, it is suggested that by increasing pre-alerts, patient outcomes can be improved. Further goals include analyzing transport times and Rankin scores to evaluate the impact of increased time to ED on outcome. Limitations of this study include the lack of complete data sets obtained for patients without pre-alert. Only 8.39% of patients were not pre-alerted prior to arrival, suggesting a low percentage of patients that were not being pre-alerted. This can be viewed as a positive finding, as pre-alerting has been shown via our analysis to have decreased door-to-needle times, suggesting improved patient outcomes.

Obstetrics & Gynecology

9 A Randomized Trial of Vaginal Prep Solutions to Reduce Bacteria Colony Counts in Patients Having Vaginal Surgery

Boeckley, Andrew Nicholas; Saelens, James; Castillo, Natalie;, Maxwell, Rose; Langer, Adam; Espenschied, Jennifer; Muterspaw, Kelly; Stump, Hannah; Towers, Geoffrey

Mentor: Maxwell, Rose

Surgical site infections remain a leading complication of vaginal procedures, incurring significant post-operative morbidity and cost. While the individual effectiveness and side effect profile of various antiseptic vaginal preparations has largely been determined, a head-to-head comparison of commonly used agents is needed to inform appropriate standards of care. Additionally, there is currently limited evidence for the use of baby shampoo as an antiseptic in vaginal surgery. The objective of this randomized controlled trial was to compare the effectiveness of betadine, baby shampoo, Techni-Care and Peridex preparations for reducing bacterial colony counts and minimizing postoperative irritation and infection in vaginal surgeries. Patients at least 18 years of age undergoing vaginal surgeries requiring vaginal incision were randomly assigned to one of four preparations. Bacterial/fungal colony counts were assessed by performing pre-scrub, post-scrub, and postprocedural vaginal swabs that were analyzed with Matrix Assisted Depolarization/Ionization Time of Flight mass spectrometry (MADI-TOF). Age, BMI, smoking history, preoperative antibiotics, length of hospital stay, and postoperative complications data were collected by chart review. The study was powered to detect statistical significance (power=80%, p = 0.05) with 60 total participants (15 in each arm). Primary outcomes were bacterial colony count reduction and postoperative irritation and infection scores. Interim analysis (N=14) with average patient age of 44 years (SD, 9.3) revealed no statistically significant difference in pre-scrub, post-scrub, and post procedure mixed aerobic (p= 0.45, 0.30, 0.49) anaerobic (p = 0.31, 0.11, 0.79), or fungal (p= 0.31, n/a, n/a) colony counts. No difference was found in vaginal irritation/burning and infection scores at two days (p= 0.53, 0.53), two weeks (p= 0.49, 0.11), or one month (no itching/burning or infection reported in any treatment arm). This interim analysis does not conclude any significant differences in colony count reduction, postoperative vaginal irritation, or infection rates between the four vaginal surgical preparations.

10 Furosemide for Postpartum Management of Hypertensive Disorders: A Randomized Controlled Study

Johnson, Holly Marie; Herr, Margaret J.; Maxwell, Rose A.; Candela Zachary; Barham, Sheela
Mentor: Maxwell, Rose

Background: Loop diuretics have been investigated for managing postpartum hypertensive disorders, but there is currently insufficient clinical evidence pointing to any single agent. This study aims to compare blood pressure (BP) outcomes for patients with gestational hypertensive disorders receiving labetalol alone versus labetalol + furosemide during postpartum hospital stay. The primary aim was to learn if loop diuretic incorporation in conjunction with labetalol could lower the need for additional anti-hypertensive agents. Methods: Patients were randomized to receive labetalol alone (200mg) or labetalol + furosemide (200mg and 20mg) on Day 0 postpartum after establishment of baseline BP. Labetalol dosing was increased per standard practice as indicated to maintain BP control. BP values were monitored throughout postpartum hospital stay and at a postpartum visit 14 days after discharge. Statistical analysis evaluated the effect of furosemide on systolic BP, diastolic BP, mean arterial pressure (MAP), additional hypertensive agent (Labetalol dose increase or switch to Nifedipine), urine output, and length of hospital stay. Results: Thirteen patients were enrolled; Seven received labetalol alone and six received labetalol + furosemide. Two patients were excluded due to missing BP data. The experimental group receiving furosemide did not differ from the labetalol-only group for average daily BP outcomes (systolic, diastolic, and MAP) on Day 0, Day 1, and Day 2. Three patients in the labetalol + furosemide required dose increases compared to zero patients in the labetalol alone group. Patients receiving labetalol + furosemide had higher 24-hour urine output (4670.0±1497.2) than patients receiving labetalol alone (2552.1±1779.6; p=.056). Conclusion: Outcomes for patients receiving labetalol + furosemide did not differ from outcomes for patients receiving labetalol alone. Contrary to expectations, patients receiving labetalol + furosemide required labetalol dose increases while none of the patients receiving labetalol alone had dose increases. In this small sample, the addition of furosemide did not reduce labetalol dose escalation.

11 Master Regulators of Oxygen Sensing and Cellular Energy in the Human Placenta are Significantly Associated with Early-Onset Preeclampsia

Johnson-Gonzalez, Courtney Breann; Chandiramani, Chandni; Linkous, Bryce; Nolan, Kailey; Stone, Emily; Maxwell, Rose; Dhanraj, David; Brown, Thomas L.

Mentor: Brown, Thomas L.

Preeclampsia is one of the most serious complications in pregnancy and can progress rapidly. It is a leading cause of maternal and fetal morbidity and mortality, making it a major public health issue in the field of obstetrics. While this condition has been studied extensively, many questions still remain about how preeclampsia develops. In this study, we evaluated critical pathways that may be involved in early-onset preeclampsia. Using placental tissue from healthy control and preeclamptic patients, placental samples were analyzed for levels of important metabolic proteins. Adenosine monophosphate kinase (AMPK) and hypoxia-inducible factor 1 (HIF-1a) protein levels were found to be significantly elevated when compared to the controls, suggesting an important role for oxygen-sensing and regulation of cellular energy in the pathogenesis of preeclampsia. These two pathways are known to induce glycolytic metabolism in other tissues. Downstream proteins involved in the glycolytic pathway such as lactate dehydrogenase (LDHa), hexokinase (HK2), pyruvate dehydrogenase kinase (PDK1), and others were also found to be increased, indicating a switch from aerobic to glycolytic metabolism in pathogenic placentas. Our results have identified specific metabolic changes that occur in early-onset preeclamptic placentas and provides much needed insight into how this devastating condition may affect placental function and lead to pathogenesis.

12 Risk Factors and Racial Disparities of Maternal and Neonatal Morbidity at Premier Health Maternity Facilities

Whitehead, Katie M; McKenna, David; Maxwell, Rose
Mentor: McKenna, David

Nationally, racial disparities in obstetrical outcomes have proven to be contributing to the high maternal morbidity and mortality rates in the U.S. when compared to other developed nations. To best approach the inequalities in our community, we sought to determine if and where obstetrical outcomes were being disproportionately impacted by the race of the patient. We conducted a retrospective chart review of patients delivering singleton pregnancies at 37 weeks of gestation or greater from January 2019 to July 2021. Using the patient's self-identified race, regression modeling was used to identify disparities in obstetrical outcomes. A composite of maternal outcomes consisting of 3rd/4th degree lacerations, blood transfusion, febrile morbidity, and ICU admission was used to compare morbidities. Neonatal composite morbidity consisted of respiratory distress, sepsis, need for resuscitation, and NICU admission. Study approved by the Wright State University Institutional Review Board (protocol number: 07272). There were 13,689 births during the study period. Significantly more non-Caucasian patients experienced cesarean sections than Caucasian patients (30.3% vs. 28.5%; $P < 0.01$), and on average had a higher maternal composite score (0.5 vs. 0.03; $P < 0.01$). Black or African American babies were more likely to qualify as small for gestational age, be admitted to the NICU and have a higher composite score than Caucasian babies ($P < 0.01$). Within our community, obstetrical and neonatal outcomes were experienced at significantly different rates by different race groups. Next steps include creating standardized protocols to decrease the opportunity for implicit bias to adversely affect patient care.

Orthopedic and Plastic Surgery

13 Patellofemoral Pain Syndrome: A Case Report

Bohne, William Jeffrey; Eifert-Mangine, Marsha
Mentor: Eifer-Mangine, Marsha

Background and purpose: Patellofemoral pain (PFP) is one of the most common forms of knee pain, with a prevalence cited between 15-45%. However, there is not a consensus among clinicians as to what the best treatment guidelines are for conservative management of PFP. Among various interventions cited in the literature such as taping, bracing, stretching, spinal manipulation, exercise, and modalities, exercise has the strongest evidence base but the exact form and dosage of exercise has not been determined. Current research shows that isometric, isotonic, and closed chain quadriceps strengthening exercises are all effective for rehabbing PFP, but there is not clear evidence regarding which exercise is the most effective. The purpose of this case report is to describe the conservative management of a patient with PFP to contribute to a better understanding of which interventions are the most effective for treating PFP. Case description: The patient in this case report is a 47-year old male who presented to physical therapy with a chief complaint of left anterior knee pain that was preventing him from running. His knee began bothering him during an 8-mile run. Upon completion of his run, he noted a high level of pain in his left knee as he was driving home. This prompted him to see his primary care physician who prescribed anti-inflammatory medication and rest. He was given oral steroids and a prescription for physical therapy after a follow-up with his doctor, since the initial medication and rest did not improve his pain. Outcomes: The patient was treated for a total of 6 weeks and was able to incrementally increase his pain-free running distance to a total of 4 miles by the end of week 6. The patient demonstrated improved manual muscle test scores to 5/5 in his global lower extremities and increased flexibility in his bilateral piriformis and hamstring muscles. He stated that his pain had decreased in severity from an 8/10 to a 2/10 at its worst on the NPRS. The patient scored a 91.25% on the LEFS upon re-evaluation at 6 weeks, an increase of 12.5% from his initial score. Discussion: An incremental approach to return-to-activity was used with this patient, with short-term success noted in just 6 weeks of therapy. Exercises were initiated in the form of light weight isometrics and gradually progressed to open-chain isotonics and closed-chain dynamic activities, with an emphasis on minimizing pain with performance. After a stretching and strengthening program was initiated, the patient was instructed to gradually attempt pain-free treadmill running, starting at a distance of 0.5 miles. This distance was incrementally increased by 0.5 miles per visit until the patient was able to run 4 miles without pain.

Pharmacology and Toxicology

14 Pharmacological Manipulation of the Circadian Clock Protects Human Keratinocytes from UVB Exposure

Cvammen, William; Kemp, Mike
Mentor: Kemp, Mike

Humans are regularly exposed to substances in the environment that can form bulky adducts on DNA which are potentially mutagenic to target tissues if not removed properly. Unfortunately, exposure limitation is not always possible; therefore, the development of new strategies for enhancing our innate ability to respond to, and deal with, DNA damage may offer therapeutic and preventative approaches that limit disease risk in susceptible individuals. Thanks to recent discoveries showing that aspects of the DNA damage response (DDR) mechanism is regulated by the circadian clock transcriptional machinery, as well as the development of small molecules that target core clock genes, it may now be possible to pharmacologically manipulate circadian output to help protect against environmental stressors. To explore this hypothesis, we used REV-ERBα antagonist SR8278, and cryptochrome inhibitor KS15 alone, and in combination, to pre-treat cultured keratinocytes prior to UV irradiation. Short and long-term cell survival assays show that the combination of SR8278+KS15 are able to significantly increase keratinocyte viability against UVB exposure compared to vehicle control. Furthermore, human skin explants treated topically with SR8278 and KS15 displayed altered expression of core clock genes as well as modestly increased expression of clock controlled genes known to be important in the DDR, including the DNA repair gene XPA and cell cycle gene Wee1. These results provide the first evidence that clock modulating compounds may lead to improved DDR following exposure to various environmental genotoxins.

15 Significance of the PTAFR Signaling in Clinical Characteristic of Human Malignancies

Stammen, Bailey Nicole; Thyagarajan, Anita; Sahu, Ravi P.
Mentor: Sahu, Ravi P.

Platelet-activating factor receptor (PTAFR) is a G protein-coupled receptor known to play critical roles in metastasis, angiogenesis, tumor transformation, and anti-apoptosis in several cancers. However, its involvement in certain human malignancies hasn't been thoroughly investigated. Our objective was to identify those malignancies exhibiting significant levels of PTAFR expression and genes correlated with PTAFR that have functional significance in tumorigenesis. Data analysis was performed using The Cancer Genome Atlas Project (TCGA). TCGA displayed the genes positively correlated with PTAFR in each cancer and the effect of gene expression on patient survival. The cancers having a highly significant elevation in PTAFR expression in tumor samples were selected for further analysis. Next, the PTAFR-correlated genes with Pearson correlation coefficients ≥ 0.5 were examined for their functional significance. We identified five cancer types to have significantly higher expression of PTAFR in tumor samples compared to normal samples: cholangiocarcinoma (CHOL), glioblastoma multiforme (GBM), kidney renal clear cell carcinoma (KIRC), stomach adenocarcinoma (STAD), and uterine corpus endometrial carcinoma (UCEC). We focused our analysis on the top three most significant genes in the five cancer models, whose mechanisms were supported by published literature. Neutrophil cytosolic factor 1C (NCF1C) has a significant survival profile in both GBM and UCEC, and CD300C has a significant survival profile in CHOL and KIRC. These genes play crucial roles in regulating various oncogenic properties of tumor cells such as apoptosis, cell proliferation, ferritinophagy, tumor infiltration of macrophages, and T cell-mediated immune responses. As PTAFR modulates tumor cell properties, including apoptosis, cell proliferation, and T cell-mediated immune responses, the identification of PTAFR-associated genes that regulate such cancer cell properties can be explored as potential targets for the intervention of these malignancies. Importantly, our analyses showed the relevance of these important genes and their use as biomarkers that could be helpful for personalized therapy.

Population & Public Health

16 How does virtual learning impact student confidence and exam performance in an immunology course?

Chong, Christian Taewon; Silva, Annelise M.; Todd, Amber; Stolfi, Adrienne
Mentor: Stolfi, Adrienne

Virtual classrooms have emerged as an important new setting for medical education. Previous studies have primarily focused on virtual curriculum satisfaction. However, investigating its effects on preclinical performance and confidence has resulted in conflicting outcomes. De-identified self-reported confidence data, gender, MCAT percentiles, and final exam score were analyzed for the Class of 2024 (C2024, n=115, virtual due to the COVID-19 pandemic) and 2025 (C2025, n=126, in-person). Confidence was scored as slightly, moderately, or extremely at the beginning and end of class sessions. Cohorts were compared on gender (chi-square), confidence (Mann-Whitney U), MCAT percentiles and exam scores (two-sample t tests). The association between confidence and exam scores was assessed with linear regression. Overall, 57.3% of students were female, and mean (SD) MCAT percentile was 68 (18), with no differences between classes. Mean confidence scores for C2024 were significantly higher compared to C2025 [1.49 (0.34) vs. 1.40 (0.35), P=0.019]. There was no difference in exam scores between the two cohorts [82 (10) C2024 vs. 81 (10) C2025, P=0.767], and confidence was not associated with exam performance. Students in the virtual cohort reported higher confidence, while exam performance was unchanged between virtual and in-person environments. The results of this study support existing literature that has found no negative impact on performance or confidence with an online environment.3–5 The difference in confidence between cohorts may reflect differences in classroom modalities or external variables. The use of a 3-point Likert scale limit our conclusions. The lack of variance in student performance, and increased confidence for C2024, suggest online education is not detrimental to students.

17 Examining the impact of virtual learning on Step 1 performance.

Chong, Christian Taewon; Silva, Annelise M.; Todd, Amber; Stolfi, Adrienne
Mentor: Stolfi, Adrienne

Virtual classrooms are an important new setting for medical education, with literature suggesting conflicting outcomes of online environments. While previous studies have focused on performance within individual virtual curricula, the effects on Step 1 performance remains scarcely studied. De-identified data on gender, MCAT percentiles, and first-attempt Step 1 pass/fail status were compared between two medical school classes at a single institution. Due to the COVID-19 pandemic, the Class of 2024 (C2024) had the first 42 weeks (60%) of the 70-week basic sciences curriculum in a virtual classroom. The Class of 2025 (C2025) had all courses in-person. Gender and proportion failing Step 1 were compared with chi-square tests. MCAT percentile, which was used to control for baseline performance on a standardized test, was compared with a two-sample t test. Multiple logistic regression was used to determine C2024's adjusted odds ratio (AOR) and 95% confidence interval (CI) for failing Step 1 after controlling for MCAT percentiles. A total of 117 students in C2024 and 120 in C2025 were included. There was no difference in gender between classes (females: 60.7% C2024 vs. 50.8% C2025, P=0.127). The mean (SD) MCAT percentile was significantly lower for C2024: 66.1 (18.6) vs. 71.1 (17.3) C2025, P=0.035. After controlling for MCAT percentiles, the AOR (95% CI) of failing Step 1 for C2024 was not statistically significant (1.22 [0.050-2.96], P=0.653). The lack of a difference in Step 1 performance between the cohorts supports existing literature that suggests online education is not detrimental to student performance. The use of a single test outcome limits our conclusions. Our findings suggest an online component of medical school curriculums may be a point of focus to improve medical education and pre-clinical/clinical performance.

18 Vision Loss and Substance Misuse: a Systematic Review

Prater, Amber Jean; McClintock, Heather; Anderson, Joanna
Mentor: Hinson-Enslin, Amanda

The number of people in the United States affected by sensory disabilities and/or substance use has continued to increase, but the relationship between them has yet to be fully understood. The purpose of this review is to assess the extent of this relationship in the United States as described by current literature. A search of published literature was conducted across MEDLINE, APA PsycINFO, Web of Science, and EBSCO: Psychology and Behavioral Sciences Collection and CINAH following the Preferred Reporting Items for Systematic Reviews and Meta Analysis (PRISMA) protocol. Risk of bias was assessed by the authors based on study design. United States based studies written in English between 2010 and 2022 that reported on vision loss and substance use were included. 21 articles were included (case reports 11, case series 1, cross-sectional 4, observational 1, retrospective cohort 2, review 2) representing 89,132 patients. Seventeen studies found a positive association between vision loss and substance abuse, with 15 studies suggesting substance use was a risk factor for vision loss. One study reported on vision loss preceding substance misuse but was inconclusive. Our findings suggest that substance misuse may be a risk factor for vision loss, and we recommend that providers screen for vision loss in at risk patients to mitigate further disability. Further research is needed to assess the impact sensory disabilities may have on substance misuse, and stronger evidence is needed to verify if substance misuse is truly a risk factor for vision loss.

Psychiatry

19 Gabapentin in Autism Spectrum Disorder: A Systematic Review

Chidambaram, Maneesh Madhan; Gupta, Nihit; Harper, Bethany
Mentor: Gupta, Nihit

Introduction Autism Spectrum Disorder (ASD) is characterized by difficulties in social communication and restricted behaviors and interests. As non-pharmacologic care has limited availability, there is an increased reliance on medications, though only two, risperidone and aripiprazole, are FDA-approved. Background Gabapentin is commonly prescribed to children with ASDs, however, its use is off-label since it is not approved for use in ASD and there is a limited amount of evidence. Aim Review the evidence regarding the efficacy and safety of Gabapentin in individuals with ASD. Method In accordance with predefined criteria, a systematic search of literature databases was conducted. P: Individuals under age 18 with ASD. I: Gabapentin. C: Treatment as usual/placebo. O: Primary outcome: Anxiety and Irritability symptoms. Secondary outcomes: Core symptoms of ASD and Insomnia. In this review, two authors independently conducted the search and mutually agreed upon the articles for inclusion. Results We were unable to identify studies except one addressing irritability associated with ASD, none on gabapentin for anxiety-associated autism, one retrospective chart for insomnia, and none on the core symptoms of ASD. The strongest evidence was the retrospective chart review of 23 kids with neurodevelopmental disorders, of whom nine had ASD. Eight of the nine reported improvements in insomnia. Despite gabapentin showing promise, high-power studies are needed since this was a small study with poor-quality evidence. We also found a case report of a 27-year-old male with ASD and disruptive behaviors. Risperidone 6 mg was augmented with gabapentin 400 mg TID resulting in decreased aggressive and compulsive behaviors evident on the Clinical Global Impression-Improvement (CGI-I) and CGI-Severity of Illness (CGI-S) scales. Conclusion Evidence supporting the use of gabapentin in ASD is lacking. With the scarcity of evidence-based treatment for ASD and the anecdotal benefits reported by multiple physicians, gabapentin should be considered for further research.

Surgery

20 Outcomes of Primary Vitrectomy for Rhegmatogenous Retinal Detachment: Interventional Retrospective Consecutive Case Series of 116 Patients with no Post-operative Positioning

Babel, Adrian Tomas; Xu, Kunyong; Chin, Eric K.; Almeida, David
Mentor: Almeida, David

Purpose: The role of face-down posturing following rhegmatogenous retinal detachment (RRD) repair remains a consistent management component; however, there is no direct evidence to allow firm conclusions as to what role face-down positioning plays following RRD repair with modern micro-incisional vitrectomy surgery (MIVS) platforms. We evaluated the anatomic and visual outcomes of primary vitrectomy for RRD repair, employing no amount of post-operative prone positioning (POPP) to clarify the role of face-down posturing for RRD re-attachment. Methods: Retrospective consecutive interventional case series of 116 eyes in 116 patients undergoing primary vitrectomy for RRD repair. Surgical outcomes, single surgery anatomic success (SSAS), and post-operative best-corrected visual acuity (BCVA) were investigated. The primary objective is to study the anatomic and visual outcomes of vitrectomy RRD re-attachment employing no POPP. Results: SSAS was achieved in 112 (96.5%) of 116 eyes; SSAS was 100% in phakic patients (n=56) and 93% in pseudophakic patients (n=60), with both groups experiencing a mean improvement in BCVA. Conclusions: Primary vitrectomy with no POPP is a successful surgical intervention for RRD repair. Our current anatomical closure rate is one of the highest reported in the literature and involved a large number of macula-off RRDs, with minimal complications and significant improvement in BCVA, primarily using 14% C3F8 for gas tamponade.

21 The Variable Perceptions of General Surgery Residents on Surgical Simulation Models in Colon Resection Procedures

Leake, Michael Le; Zhao, Zhizhen
Mentor: Balta, Joy

Traditionally, surgical skills have been acquired in the operating room on live patients. However, due to new resident work-hour restrictions, ethical and patient safety concerns, and the limitations of both traditionally fixed formaldehyde-embalmed and fresh-frozen cadavers, surgical skills acquisition has increasingly shifted to the use of porcine models. Under ideal circumstances, surgical skill and knowledge acquisition should accurately reflect live operating conditions. And while the porcine and human body donor models have been compared previously, little is known about the alcohol-based Imperial College of London Soft-Preservation technique and its utility in surgical residents' learning of colon resection procedures. Applying a mixed-methods study design, we administered Likert-scale surveys to general surgery residents and conducted semi-structured interviews with surgical faculty attendings to obtain quantitative and qualitative data on surgeon perspectives. While both the porcine and alcohol-preserved human body donor models were perceived as being beneficial in resident education, surgeon accounts highlighted the limitations of each model and simultaneously identified a correlation between experience level and preference of simulation modality. Moving forward in seeking to advance surgical learning, optimal education should employ a combined approach utilizing both the porcine and human body donor models to maximize resident knowledge and skill acquisition, while also taking surgical experience level into account when determining ideal simulation modalities.

Boonshoft School of Medicine *and* College of Science & Mathematics

Biochemistry and Molecular Biology

22 TIP60 Mediated Regulation of ΔNp63α is Associated with Cisplatin Resistance

Hira, Akshay; Kemp, Mike; Stacy, Andrew J.; Zhang, Jin; Kadakia, Madhavi
Mentor: Kadakia, Madhavi

About 5.4 million basal and squamous cell skin cancers are diagnosed each year in the US. The chemotherapeutic drug, Cisplatin is often used to treat squamous cell carcinoma (SCC) patients, but low response rates and disease recurrence is common. ΔNp63α, a member of the p53 family of transcription factors, is overexpressed and considered oncogenic in non-melanoma skin cancer where it regulates cell survival, promotes proliferation and inhibits cell apoptosis. ΔNp63α has also been shown to promote resistance to cisplatin by transcriptionally regulating several DNA damage response (DDR) genes. A previous study from our lab showed that the histone acetyltransferase (HAT) TIP60 promotes SCC proliferation by positively regulating ΔNp63α protein levels in manner dependent on the catalytic activity of TIP60. This finding suggested that TIP60 may contribute to the failure of platinum-based drugs in SCC and led us to hypothesize that TIP60-mediated acetylation of ΔNp63α regulates its stability and transcriptional activity to promote chemoresistance. Silencing endogenous TIP60 led to a decrease in ΔNp63α transcript and protein levels in multiple SCC cell lines, indicating the positive regulation of ΔNp63α by TIP60 is not cell-line specific. Further, TIP60 levels positively correlated with ΔNp63α stability, protein levels and cisplatin resistance. Stable expression of TIP60 or ΔNp63α individually promoted resistance to cisplatin and reduced cell death, whereas loss of ΔNp63α and TIP60 induced G2/M arrest, increased cell-death and sensitized cells to cisplatin. Moreover, pharmacological inhibition of TIP60 reduced acetylation of ΔNp63α and sensitized resistant cells to cisplatin. Finally, we demonstrated that ΔNp63α and TIP60 levels positively correlated with DNA repair capacity and negatively correlated with cisplatin-DNA adduct formation. Silencing of either TIP60 or ΔNp63α enhanced cisplatin-DNA adduct formation and significantly reduced expression of genes involved in DDR. Taken together, our data indicate that TIP60-mediated stabilization of ΔNp63α increases cisplatin resistance and provides critical insights into the mechanisms by which ΔNp63α confers cisplatin resistance through regulation of genes involved in DNA damage repair. Our findings suggest that inhibition of TIP60 may be therapeutically advantageous in overcoming cisplatin resistance in SCC and other epithelial cancers.

23 A Novel Role of Lipin1 in Cardiac Function

Kamau, John Karanja
Mentor: Ren, Hongmei

Lipin1 has dual functions acting as phosphatidic acid phosphatase required for lipid synthesis and as a transcriptional coactivator. Our recent study showed that lipin1 plays an essential role in maintaining plasma membrane integrity. Since plasma membrane integrity is crucial for cardiac muscle viability and functions, we evaluated the role of lipin1 in cardiac function using a novel mouse model, cardiac-specific lipin1 KO mice. We found that lipin1 deficiency in cardiac tissues led to impaired plasma membrane integrity, which resulted in increased inflammation infiltration, cardiac fibrosis, upregulation of cell death markers, and increased levels of sarcolemmal damage. Overall, these findings suggest that lipin1 has an essential role in cardiac morphology and function.

24 iGEM-WrightState Deconta-Mn-ate: Advancing Manganese Detection

Kronenberger, Zach; Shukla, Hiya; Shindkhede, Shubbangi; Gruenberg, Maddy; Kennel, Natasha; Telak, Emma; Doppalapudi, Padma Deepa; Stone, Ales; Heinlein, Ethan; Aunspaw, Harrison; Rismiller, Jeremy; Beabout, Kathryn; Chaves, Jorge; Harbaugh, Svetlana; Jacquemin, Steve; Mian, Ashan; Markooulos, Marjorie; Ekberg, Mike; Lodor, MaryLynn; Lacy, Krystal; Hira, Akshay; Zhang, Jin; Kronenberger, Andrew; Naik, Rajesh; Breedon, Amy; Goodson, Michael; Kelley-Loughnne, Nancy; Sullivan, Claretta; Long, Weiwen; Hung, Chia; Craig, Michael; Kadakia, Madhavi

Mentor: Kadakia, Madhavi

The iGEM-WrightState Deconta-Mn-ate research project is to address the urgent issue of manganese contamination in drinking water. The project is a multidimensional endeavour that combines cutting-edge research, social outreach and collaboration to address the important global water quality issue. Our goal is to provide innovative solutions for water testing and to inspire scientists and citizens to join us in this vital cause. Our project builds upon our 2022 development of an E. coli-based biosensor capable of detecting down to 0.01mM (0.5ppm) manganese. Our 2023 team adapted the biosensor to a cell-free approach, reducing assay time from 24 hours to 2 hours. Moreover, we cloned a NanoLuciferase reporter which significantly increased the magnitude of the response to manganese and enabled imaging with a mobile phone. Efforts are underway to improve the fieldability of the optimized sensor using a 3D-printed luminescence imaging device and mobile application for guided manganese quantitation. In collaboration with the Miami Conservancy District, the WSU Environmental Health and Safety department, and faculty from the WSU Lake campus, we are testing raw water samples for comparison to standard testing methods. Our project extends beyond the laboratory, as we actively engage with the global iGEM community and the public through social media. Through platforms like Twitter and Instagram, we share project progress, introduce our diverse team, and foster a spirit of collaboration in the realm of synthetic biology. Our commitment to public engagement and outreach is exemplified by our collaborative efforts with the Boonshoft Museum of Discovery, The Ohio State University and the Center of Science and Industry. Through these initiatives, we aim to raise awareness about manganese contamination and promote scientific literacy.

25 Exploring Potential Treatments to Attenuate Dystrophic Muscle

Morris, Brooklyn Peyton
Mentor: Ren, Hongmei

Duchenne muscular Dystrophy (DMD) is a devastating progressive muscular disorder affecting approximately 1 in 3,500 males. Currently, there is no cure for this disease. Our previous studies discovered that increasing lipin1 levels in dystrophic skeletal muscle strengthened sarcolemma integrity, thereby suppressing inflammation, reduced necroptosis, and improved muscle function in mdx mice (mouse model of DMD). Since choline is used to synthesize phosphatidylcholine, a major phospholipid used for maintaining cell membrane integrity, it was used to treat mdx and B10 wildtype mice for one month. Compared to untreated groups, treatment with choline showed less fibrosis, muscle damage, and reduced macrophages in both the skeletal muscle and heart of mdx mice. We will further evaluate the effects of choline on skeletal muscle and cardiac functions in mdx mice. This study will determine whether choline could be a potential therapeutic agent for the treatment of DMD.

26 Changes in Splicing of MDM4 in Human Melanomagenesis are Critical to the Control of p53 Activity and Represent Potential Therapeutic Targets

Patrick, Nehaal R; Markey, Michael P.
Mentor: Markey, Michael P.

Genomics characteristics of melanoma and precursor lesions, such as copy number variation and gene expression, have been investigated in detail. However, there has never been a detailed survey of splicing changes that occur during melanomagenesis. Our preliminary data indicate that splicing changes can be a very early event in melanoma tumor progression, with characteristic changes in the p53 pathway already in place in early nevi. MDM4 is upregulated in a strong majority of melanoma cases and has been described as a "key therapeutic target in cutaneous melanoma". Identifying splicing changes in human tissue specimens will tell us what the proteins produced in patients are likely to look like and provide therapeutic targets during initiation, dysplasia, and progression toward metastatic melanoma. Splicing has been recently characterized in melanoma in reports published by this and other laboratories. However, these studies have utilized new or existing data obtained by next-generation (NGS) sequencing. While high throughput, NGS methods (typically Illumina sequencing) rely on short reads. One difficulty associated with this type of analysis is the loss of "connectivity" data. Full transcripts are inferred from the presence of splice junction reads, but whether splice junctions co-occur in the same mRNA molecule or represent multiple unique transcripts is lost to NGS. Novel junctions can also fail to align and are discarded. For example, the data of the TCGA Skin Cutaneous Melanoma (SKCM) database rely on sequencing methods with an average read length of 35 or 330 bases. To address this problem, we will use long-read (so-called "third generation") sequencing to read the entire length of transcripts intact. This directly quantifies and identifies the transcripts, alternative and canonical, that are present in a sample.

27 Human Genome instability at (CAG)102 Microsatellite DNA Repeats

Shrestha, Resha; Leffak, Michael; Rider Jr., S. Dean;

Microsatellites are tandem repeats of short nucleotide sequences that are inherently unstable. These repeats can form non-Watson-Crick structures that can pose obstacles to DNA replication leading to double strand breaks (DSBs). When unrepaired, these breaks can threaten genomic integrity and cause various neurological diseases and cancers. These replication-induced breaks can be repaired by a highly mutagenic mechanism known as break induced replication (BIR). Here, we focus on CAG trinucleotide repeats capable of forming hairpin structures which stall the replication fork, eventually causing its collapse. Expansions in CAG repeats have been implicated in Huntington's disease and Myotonic Dystrophy. To study instability caused by this repeat, we are using an engineered HeLa cell line with dual fluorescent reporter constructs harboring a repeat of 102 CAG units in the lagging strand template adjacent to a c-myc origin of replication. This allows us to use flow cytometry, inverse PCR, and DNA sequencing to study the effects of these repeats at the single DNA molecule level. We find that the repair of these replication-induced breaks leads to 1000x elevated levels of DNA mutagenesis including insertions, deletions, base substitutions and the formation of extrachromosomal circular DNAs (eccDNAs).

Neuroscience, Cell Biology and Physiology

28 Motoneurons: Onion Skin or AHP firing scheme?

Mousa, Mohamed H; Wages, Nathan P; Elbasiouny, Sherif
Mentor: Elbasiouny, Sherif

Objective. Muscle force is modulated by sequential recruitment and firing rates of motor units (MUs). However, discrepancies exist in the literature regarding the relationship between MU firing rates and their recruitment, presenting two contrasting firing-recruitment schemes. The first firing scheme, known as "onion skin", exhibits low-threshold MUs firing faster than high-threshold MUs, forming separate layers akin to an onion. This contradicts the second firing scheme, known as “reverse onion skin" or "after-hyperpolarization (AHP)", with low-threshold MUs firing slower than high-threshold MUs. Approach. To resolve this dichotomy, we employed a high-fidelity computational model that prioritizes physiological fidelity and heterogeneity, allowing versatility in the recruitment of different MN types (where ordered, mixed, and reverse recruitment could occur) and avoids the imposition of a specific relationship; thereby, testing the conditions that lead to each of these two firing schemes without bias. Main results. Our simulations indicate that these two schemes are not mutually exclusive but could coexist. The likelihood of observing each scheme depends on factors such as the motoneuron pool activation level, synaptic input activation rates, and MU type. The “onion skin” scheme does not universally govern the encoding rates of MUs, but tends to emerge in unsaturated motoneurons (cells firing < their fusion frequency that generates peak force), whereas the “AHP” scheme prevails in saturated MUs (cells firing at their fusion frequency), which is highly probable for S-type MUs. When unsaturated, FF MUs always show the “onion skin” scheme, while S MUs do not show either one. FR MUs are generally similar but show weaker “onion skin” behaviors than FF MUs. Significance. Our results offer an explanation to the longstanding dichotomy regarding MUs’ firing patterns, shedding light on the factors influencing the firing-recruitment schemes.

29 Does Uromodulin play a role in tacrolimus-induced hypertension?

Nshuti, Adeline; Ume, Adaku C.; Wengieme, Tara-Yesomi; Williams, Clintoria
Mentor: Williams, Clintoria

Introduction: Tacrolimus, a calcineurin inhibitor (CNI), is a medication commonly prescribed to prevent organ transplant rejection. However, chronic CNI use has several adverse effects, including hypertension. Recent studies have revealed that the renal sodium chloride cotransporter (NCC) mediates tacrolimus-induced hypertension. NCC is expressed within the renal distal convoluted tubules, yet the mechanisms underlying NCC upregulation are not fully understood. Since uromodulin regulates intracellular trafficking of renal ion channels, we hypothesize that tacrolimus increases uromodulin expression to induce NCC upregulation. Methods: To test this hypothesis, wild-type C57BL/6 male mice received tacrolimus (10mg/kg/day) or vehicle (ethanol/DMSO/saline) for 21 consecutive days via intraperitoneal injection. To examine uromodulin and NCC expression, kidneys were harvested and processed for immunofluorescence. Study Objective: Our preliminary findings suggest that tacrolimus increases uromodulin expression in select renal tubules. In this endeavor, we aim to investigate whether tacrolimus-treated kidneys present any alterations in the (1) expression and (2) localization of uromodulin and NCC within the DCTs. Discussion: Collectively, this study will explore the impact tacrolimus has on the expression and localization of uromodulin and NCC within the kidney. If our hypothesis is correct, our future studies will investigate whether tacrolimus impacts (1) uromodulin and NCC association within the kidney and (2) uromodulin's modulation of NCC trafficking.

30 Usability Study of a Mobile Application Tool to Aide Therapies Targeting Improvement of Emotional Awareness and Labeling After Brain Injury

Qureshi, Fahad; Neumann, Dawn; Armstrong, Amber; Sutter, Steve
Mentor: Neumann, Dawn

• Research Objective(s): To explore clinician and patient usability of a new mobile application-based intervention, Training to Reconnect with Emotional Awareness Tool (TREAT), designed to be used by therapists treating individuals with brain injury (BI) who have poor emotional self-awareness and labeling, and/or patients with BI who want to practice these skills on their own. • Design: Survey • Setting: Community • Participants: Ten adults comprised of five clinicians (60% speech language pathologists) who primarily treat patients with BI and five adults who have had a mild to severe BI (4 traumatic brain injury; 1 stroke) and were an average of 14 years post-injury (range 7-31 years). • Intervention: TREAT is a mobile/tablet application consisting of video based, interactive exercises that helps patients gain insight into their emotions, increase emotional vocabulary, and improve their ability to communicate. • Main Outcome Measure(s): Post study system usability questionnaire (PSSUQ) total and subscales (System Usefulness; Information Quality, and Interface Quality), with lower scores indicating better usability (score range 1-7); and qualitative feedback. • Results: Clinician mean PSSUQ Total, System Usefulness, Information Quality, and Interface Quality scores were 1.49, 1.37, 1.65, and 1.45, respectively. Qualitative comments by clinicians included: “Easy to use; Intuitive; Self-paced, interactive scenarios.” As perceived by the patients with BI, the mean PSSUQ Total, System usefulness, Information Quality, and Interface Quality scores were 1.79, 1.40, 2.34, and 1.60, respectively. Qualitative comments by patients included: “Informational; User directed; Personally relatable scenarios.” • Conclusions: Preliminary usability results demonstrate that clinicians and their patients with BI perceive the TREAT application to be easy to use. Qualitative feedback indicates many features that participants liked, as well as future opportunities for enhancement to improve inherent usability. The TREAT app may be an easy-to-use tool for clinicians and patients and its effectiveness when used as part of a larger, more comprehensive treatment is still under investigation, but preliminary results are promising.

College of Engineering and Computer Science

Biomedical, Industrial, & Human Factors Engineering

31 Spinal Motor Neuron Excitability Changes in Aging

Abdul Halim, Ibrahim; 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.

32 Finite Element Analysis of Cochlear Implant Electrode

Ali, Saif; Jaykumar, Nishkrutha; Goswami, Tarun
Mentor: Goswami, Tarun

Cochlear implants are devices used to directly stimulate the auditory nerve in individuals with severe to profound hearing loss. They highlight the prevalence of hearing loss among adults and underscore the importance of cochlear implant surgery in restoring hearing function. The potential risks and complications associated with cochlear implants are investigated, along with the critical role of otolaryngology specialists in assessing patients. A crucial first step in understanding medical device failure is grasping the concept of fatigue. This type of investigation repeatedly stresses the equipment until it malfunctions. Additionally, the study delves into the challenges associated with electrode array insertion during cochlear implant surgery, which can potentially damage delicate auditory tissues. Finite element analysis (FEA) is introduced as a tool to evaluate the fatigue and safety factors of cochlear implant electrodes. The results indicate limitations in the material's long-term suitability. This emphasizes the need for a better understanding of cochlear implant components' mechanical behavior to enhance their safety and effectiveness, especially in the context of long-term use for individuals with hearing loss.

33 Brain Morphometry from Neuroimaging as a Biomarker for Alzheimer's Disease

Aniebo, Nonyelum Benedicta; Goswami, Tarun
Mentor: Goswami, Tarun

Brain Morphometry from Neuroimaging as a Biomarker for Alzheimer's Disease Alzheimer's disease (AD) ranks as the seventh leading global cause of death. In 2022, 6.5 million Americans aged 65 and older were living with AD, incurring a cost of $321 billion. AD is characterized by irreversible neurodegeneration and cognitive decline. The Alzheimer's Disease Neuroimaging Initiative (ADNI) is a worldwide research effort that supports investigations and treatments aimed at slowing or halting AD progression. The study comprised 60 participants, divided equally into AD and control cohorts, all drawn from the ADNI 1 group, with documented Functional Activities Questionnaire (FAQ) and Neuropsychiatric Inventory Questionnaire (NPI-Q) scores. Cortical atrophy, a validated biomarker, was quantified by measuring the volume and surface area of the cortex throughout the entire brain using an automated pipeline in MIMICS. A stepwise multivariate regression analysis was conducted to explore the correlation between the participants' measured cortical volume and surface area and other potential factors influencing their susceptibility to developing Alzheimer's disease. The results indicated that both cortical volume and surface area demonstrated statistically significant generic model fit ($p = 0.0004$ and $p = 0.011$, respectively). Age weighting displayed an overall significant difference in both cortical surface area and volume measured by MIMICS ($P = 0.019$ and $P = 0.0075$). Notably, the age group 65-70 years appeared to be the most significant ($P < 0.001$). Additionally, performance metrics exhibited an accuracy of 0.68. The study showcases the promising utility of voxel-based morphometry using MIMICS. Further refinement of the current automated pipeline could enhance accuracy and correlation indices. These findings provide additional evidence of brain atrophy in the pathophysiology of Alzheimer's disease, underscoring the potential of MRI morphometry in the development of AD biomarkers.

34 Design and Analysis of Acrylic Resin Transfemoral Sockets for Improved Lower Limb Prostheses

Chalise, Akshay Sai; Goswami, Tarun
Mentor: Goswami, Tarun

Approximately 150,000 lower extremity amputations are performed annually in the United States, a number projected to increase to 3.6 million by 2050. The prosthesis socket, connecting the residual limb to the rest of the prosthesis, is a critical component. Ensuring a comfortable and well-fitted socket is essential for user well-being and mobility. This study focuses on the design and analysis of the socket using acrylic resin, a thermosetting plastic known for its excellent wetting properties and inherent strength. The objective is to design a socket that guarantees a proper fit and comfort. Computational simulations using finite element analysis (FEA) were employed to predict real-world physical behavior, employing the Ansys program for mathematical evaluation and simulation of deformation under various loading conditions. Furthermore, the study evaluated the equivalent stress on the socket to ensure its structural integrity. This research addresses the increasing demand for prosthetic solutions due to rising amputation rates. The use of acrylic resin and advanced computational simulations contributes to the advancement of socket design, promising improved comfort, better fit, and enhanced structural integrity. These contributions collectively enhance the field of prosthetics by providing a foundation for developing more effective and user-centric prosthetic solutions.

35 Investigation of Thermoplastic as a Material Suitable for Prosthetic Sockets of Residual Lower Limbs

Clark, Cody; Goswami, Tarun
Mentor: Goswami, Tarun

Since 2001, approximately 1,650 U.S. troops have experienced limb loss (hands, arms, legs, or feet) during the wars in Iraq and Afghanistan. It is estimated that nearly 2 million people are living with limb loss in the United States, primarily due to vascular disease, diabetes, cancer, and trauma. The necessity for adequate prosthetic limbs is evident, particularly for those missing limbs below the knee level. For these residual limbs, the socket often requires frequent modifications and replacements to ensure it meets the user's needs. Presently, there are limitations in understanding the material properties, shape of prosthetics, and the impact of daily movement forces. This study investigates the use of thermoplastic as a material, combined with a unique socket design, for residual lower limb prosthetic sockets. Ansys software will be utilized to create and analyze a socket made of thermoplastic for a residual lower leg limb. The objective of this investigation is to augment the existing knowledge by generating new data regarding the utilization of thermoplastic in prosthetics and refining socket design. This information will benefit clinicians, manufacturers, and users, ultimately guiding the development of prosthetics in the future.

36 Prenatal Urology Consult Recommendations and Postnatal Compliance Evaluation: A Quality Improvement Project

Clark, Cody; Kersey, Kelly, Babbert, Wendy; Terry, Heather; Ching, Christina; DaJusta, Daniel; Fuchs, Molly; McLeod, Daryl; Jayanthi, Rama; Alpert, Seth

Mentor: Alpert, Seth

BACKGROUD: Various abnormalities of the urinary system arise during fetal development – from hydronephrosis to complex genetic conditions. The most successful approach to reducing the consequences of these conditions is through identification and parental education with specialized prenatal consult. Often when recommendations for postnatal imaging, medication or follow-up are given, these recommendations are not followed as planned. Through a collaborative quality improvement effort between the Urology department and Fetal Center, interventions were developed to increase patient compliance. METHODS: Fetal Urology cases at our institution were analyzed between 2020 and 2023, examining trends of postnatal patient compliance with prenatal consult recommendations. An initial postnatal patient compliance baseline of 24% (25/105) was identified, with the goal of increasing it to 50%. Key interventions included scheduling based on patient severity, the creation of delivery-focused tangible communication tools for patients and providers, and the implementation of a collaborative workflow and scheduling process within the electronic medical record system. RESULTS: 440 cases were identified between 2020 and February 2023. Interventions started in May 2021 and since then, there has been an increase in the patient compliance. Post-intervention fetal urology patients following the prenatal consult recommendations increased to 50% (148/296). The change in compliance from pre- to post-intervention implementation is statistically significant ($p < 0.001$). CONCLUSIONS: This project demonstrates the success of using a multi-faceted approach to to 'close the loop' on patient's prenatal Urology consult and appropriately schedule their postnatal appointment. Overall, these interventions were implemented to prevent complications and improve quality of care for patients with urology conditions. Future steps include implementing a more streamlined electronic solution that can be utilized by all parties involved in the care of these patients. Methods used in this project can be readily extrapolated to other prenatal conditions to improve the outcome in cases for specialties other than Urology.

37 Dysregulation of Persistent Inward Currents in Spinal Motoneurons of Symptomatic SOD1-G93A Mice

Deutsch, Andrew; Elbasiouny, Sherif
Mentor: Elbasiouny, Sherif

Persistent inward currents (PICs) is a group of ion channels whose net current regulates the firing of spinal motoneurons (MNs). Past studies have reported conflicting results on how the net PIC is affected in ALS. Also, the PIC components have never been measured in ALS before. To address that gap in knowledge, we directly measured individual PIC components (sodium, calcium, and SK currents) using electrophysiology voltage-clamp experiments. Here we show, for the first time, that all PIC components are altered in SOD mice (the standard animal model of ALS), leading to an increased motoneuronal net PIC and contributing to increased intrinsic excitability of SOD MNs, relative to WT cells. Specifically, relative to WT, sodium and calcium PICs were upregulated in the disease, throughout both symptom onset and advanced disease stages, whereas the ratio of SK/Ca PIC was reduced at the same disease stages. Together, our results fill a gap in knowledge on how the different PIC components are affected in SOD mice with disease progression. They also provide insights on the contribution of PIC upregulation to MN excitability dysfunction and the failure of homeostatic mechanisms in SOD MNs.

38 Semantic and Composable Glyphs for Representing AI Systems

Ellis, Alexis; Bihl, Trevor; Shimizu, Cogan; Ganapathy, Subashini; Hugh, Salehi
Mentor: Shimizu, Cogan

The rapid integration of Artificial Intelligence (AI) into various domains has created friction in interdisciplinary communication between users of AI systems, resulting in the need to create a better means of comprehending—and communicating about—the inner workings of AI systems so that they can be more ably utilized in scenarios. Therefore, we have begun developing a visual framework using semantic and composable glyphs (i.e., visual symbols) that will communicate the structure, purpose, and characteristics of an AI system to prospective users. This will provide an intuitive, and deterministic language representing the complex inner workings of these systems, using established practices in symbology and knowledge engineering. We have started by building a glyph set that will be generalizable to accommodate both common and obscure AI systems while remaining highly understandable. The glyphs will convey information about individual components, including functionality, expected types of input and output data, model parameters and hyperparameters, and indicators of and for bias or error. We have already begun identifying AI components through surveying AI literature, which gives us a foundation for modeling more exotic AI systems. We will evaluate our glyphs through expert opinion, user studies, and tool development, with the purpose of comparing AI system functionality to user understanding through only exposure to symbolic representation. Consequently, our work helps accelerate AI system development, foster trust between domains, and serve as a benchmarking tool for comparing AI systems.

39 Advancements in Traumatic Brain Injury Research: Understanding Cranial Injury Mechanisms for Improved Assessment and Prevention

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

The last several decades have brought to light the effects of TBI within the populations of athletes, civilians, and military personnel on the front-line of the war on terror. The events causing the TBI can be traced to a definitive event causing the cranial injury. Annually, 2.8 million Americans seek healthcare treatment for TBIs, costing $76.5 billion, although the statistics may be up to 10 times higher due to unreported cases. 30% of Americans die from TBIs, and 15% - 20% of military members from Afghanistan and Iraq return with a TBI, of which 80% result from blast injuries. Continued research is required to understand the human skull's mechanical, chemical, structural, and material properties to aid in developing objective criteria to evaluate TBI severity, treatment, and prevention. One aspect of quality data collection is determining which material is best suited to assessing fracture behavior. A greater understanding of the biomechanics of skull fractures will provide insight into prevention and treatment. The study objectives are: 1. Evaluate the closed and penetrating TBIs. 2. Determine the accuracy of energy absorption and displacement of the skull subjected to a projectile in fresh human cadavers, embalm cadavers, and finite element analysis of the human skulls. An extensive literature review was conducted to extrapolate data on energy absorption and displacement in both closed and penetrating TBIs. Numerous testing methods employed in cranial testing and specimen preparation have been reported within the field, such as fresh human cadavers and embalmed cadavers, and finite element analysis. The expected outcome is that a significant difference in the energy absorption and displacement will be evident in the different specimen preparation. The analysis provides quantified data to standardize the methodology and adjust data based on the specimen preparation in terms of in cranial research.

40 Spinal Motoneurons Sex-Dependent Size and Type Changes in Aging

Gerber, Kalin; Garrett, Teresa; Elbasiouny, Sherif
Mentor: Elbasiouny, Sherif

A well-known consequence of aging is muscle weakness, the cause of which has long been attributed to muscular atrophy. However, little research has been done about the anatomical changes different alpha-motoneuron (α-MN) types experience during aging and whether these changes are sex dependent. To answer that, this study measured the size and density of lumbar slow (S), fast fatigue-resistant (FR), fast-intermediate (FI), and fast-fatigable (FF) α-MN types in young (3-4 months), middle-aged (11-13 months), and old (>26 months) male and female C57BL/6 mice. α-MNs were typed using immunohistochemistry labels via novel protocols that we developed. α-MN soma size was measured from the largest 2D cross-sectional area (LCA), and cell density was measured as the number of α-MNs per unit tissue volume. Our results show that α-MNs undergo type and sex-dependent anatomical changes during aging. Specifically, while male and female young α-MNs have similar size, old female α-MNs are smaller than old male cells. For density, female α-MNs had lower cell density than male α-MNs. For α-MN types, larger fast cells, specifically FI, are the most vulnerable in both males and females with FI cells having declining density with aging. Together, these results provide novel data on the anatomical changes α-MN types undergo during aging in males and females.

41 Bioenergetic Analysis and Anthropometric Evaluation of Bra-Breast Interface for Improved Design and Breast Health

Hamandi, Farah Mohammed Ridha Abdulateef M; Goswami, Tarun
Mentor: Goswami, Tarun

The interface between bras and the breast region assumes a vital role in the design of bras aimed at optimizing breast health and comfort, particularly during physical activities. This study is dedicated to the comprehensive assessment of anatomical compatibility between the female breast and bras. An extensive breast anthropometric analysis was conducted, employing precise measurements and establishing a measurement topology to meticulously assess breast mass, volume, shape, and asymmetry under varying loading conditions—either with a bra (loading) or without a bra (unloading). Bioenergetic assessments of the breasts were conducted and systematically compared with corresponding data from the rest of the body, utilizing the amassed anthropometric data. The bioenergetic analysis discerned that larger breasts may necessitate a substantial energy input, potentially reaching up to 69J during walking. Considering a spectrum of breast shapes—standard, semi-conical, semi-spherical, and semi-elliptical—the volume of the breast was computed, showcasing consistently disparate volume predictions among the various shapes. Notably, semi-conical and semi-spherical breast shapes consistently indicated a lower volume compared to standard and semi-elliptical shapes for identical breasts. A mathematical delineation of the medial-lateral boundaries of the breast emphasized the implications for bra fit and support due to eccentric loading, notably when the breast nipples were situated on divergent transverse planes, highlighting the necessity for bra redesign to accommodate such asymmetry and enhance overall fit. This investigative endeavor debunked the prevalent assumption in contemporary bra design, illustrating the inherent asymmetry characteristic of the female breast. Given the staggering prevalence of incorrectly sized bras among women, approximating 80%, addressing this asymmetry is pivotal. Strategic bra redesign that integrates the inter-nipple distance holds immense promise in augmenting support, bolstering comfort, and reducing breast movement. The present study underscores the critical importance of bra cup positioning to attain effective support and accentuate the natural breast contour. A redesign of prevailing bra models stands to significantly ameliorate discomfort experienced by women, presenting a tangible pathway towards improved breast health and well-being.

42 Comparative Analysis of Prosthesis Socket Materials Given Various Socket Materials and Varying Percentages of Residual Limb Length

Kanagala, Venkata Sivameghana; Whitestone, Jennifer; Goswami, Tarun; Neupane, Samikshya; Clark, Cody; Dharanikota, Venkata Gopi; Chalise, Akshay Sai; Manghe, Fidelis Obi; Pandey, Sudeep

Mentor: Goswami, Tarun

This study is the result of a class project by graduate students in Orthopedics and Prosthetics at Wright State University. Limb amputations can happen due to injury or health conditions. Regardless of the cause, prosthetics are needed to restore function after an amputation. Transtibial amputations are below the knee, leaving the knee joint intact. However, there is significant force on the residual limb from the prosthetic during walking and other activities. Critical factors in lower limb prosthetics are fitting the shape of the residual limb and using materials that can withstand the patient's weight and forces from the foot. The goal here is to analyze socket materials for residual limbs of different lengths - 50%, 65% and 85% of the original length. We developed a finite element model of the socket in ANSYS and tested its strength and stress in static and dynamic conditions. 7 investigators researched the properties of different materials and quantified stress, strain, lifespan, durability, and robustness. The forces mimic those during amputee gait. We compared the materials given the parameters. In conclusion, this can improve prosthetic design, patient experience, durability, and cost-effectiveness. Overall, it advances the field of orthopedics and prosthetics.

43 Synovial Fluid Protein Models Indicative of Progression of Osteoarthritis

Mallets, Joshua; Hicks, Celeste; Goswami, Tarun
Mentor: Goswami, Tarun

Osteoarthritis (OA) is one of the most common forms of arthritis, characterized by the wear and deterioration of hyaline cartilage located at the articular end of diarthrodial joints. Hyaline cartilage, a firm yet slick tissue, facilitates load distribution and lubrication within the joint. When it degrades, the bones within the joint abrade against each other, resulting in changes in bone structure, connective tissue destruction, synovium inflammation, and pain for individuals with this condition. Synovial fluid, a viscous liquid found in diarthrodial joints, offers lubrication and nutrients for the hyaline cartilage. During the progression of OA and breakdown of cartilage, specific proteins are released into the synovial fluid as the body combats degradation. Literature, through a comprehensive protein analysis of individuals with OA, has identified sixteen upregulated proteins in osteoarthritic synovial fluid. These proteins serve as promising biomarkers for detecting early stages of OA and monitoring its progression. Consequently, understanding these biomarkers to a greater extent is imperative. By simulating these biomarkers in water using VMD and NAMD molecular dynamics software, data regarding the energies of each protein can be collected and utilized to characterize individual protein stability. This stability assessment can then be correlated with biomarker measurement viability and the progression of OA itself. Hence, the research presented in this article contributes to a more comprehensive understanding of OA biomarkers and their energy properties.

44 Comparative Gait Analysis in Professional Dancers and Non-dancers

Manghe, Fidelis Obi; Goswami, Tarun
Mentor: Goswami, Tarun

Comparative Gait Analysis in Professional Dancers and Non-dancers Abstract: This research utilizes gait analysis as a potent instrument to decipher the subtleties in gait patterns that distinguish professional dancers from non-dancers. The study conducts an examination of the head, neck, shoulder, spine, hip, knee, and ankle positions in two sagittal (SP) and frontal (FP) planes. Additionally, it meticulously records the angles of the shoulder, hip, knee, and ankle in both S and F planes. In the first experiment, a group comprising four professional ballet dancers and six non-dancers undertook walks at five different speeds. The second experiment involved the same four professional dancers performing six distinct dance routines. Data capture was accomplished using a motion capture camera system, Kinetics, with a specific focus on maximum and minimum angular velocity during ballet dance moves. The results indicate notable differences, including the least maximum angular velocity of -0.47 rad/s and a minimum of 0.71 rad/s during nondancers' right shoulder movement. Conversely, the dancer exhibits the least maximum angular velocity of -0.09 rad/s and a minimum of 0.07 rad/s in the right shoulder. Moreover, the right knee demonstrates the highest angular velocity deviations from the nondancer, with a maximum of -3.88 rad/s and a minimum of 2.61 rad/s, while for the dancer, the maximum is -0.35 rad/s and the minimum is 0.54 rad/s. This suggests that the angular velocity differences likely reflect the varying roles and movements of different joints during the analyzed activity. Understanding these angular velocity patterns and differences is crucial for assessing joint function and biomechanics, and potentially identifying areas where targeted training or intervention may be needed. These findings hold extensive implications, ranging from injury prevention and rehabilitation strategies to performance enhancement, benefiting both the dance community and the broader population.

45 Comparative Analysis of Prosthetic Socket Stainless Steel Materials Across Varying Residual Limb Lengths

Manghe, Fidelis Obi; Goswami, Tarun
Mentor: Goswami, Tarun

Limb amputations can result from a range of causes, including traumatic incidents and underlying health conditions. Irrespective of the trigger, the restoration of function through prosthetics becomes a paramount concern following limb removal. Specifically, amputations performed below the knee are known as transtibial amputations, preserving knee function but imposing a substantial burden on the residual limb, which must bear the weight during activities like walking and light exercises. Effectively designing lower limb prosthetics hinges on two pivotal factors: achieving a precise fit with the residual limb's shape and selecting materials capable of withstanding both the patient's weight and the reactive forces originating from the foot. This modeling endeavor aims to evaluate various materials used for the prosthetic socket, contingent on the length of the residual limb—namely, at 50%, 65%, and 85% of the original length. Employing an ANSYS-based finite element model, the socket is subjected to rigorous static and dynamic tests to assess its strength and stress-bearing capabilities. Stainless steel is the chosen material, and comprehensive research into its physical properties is conducted to gauge longevity, durability, and resilience while quantifying stress and strain within the socket. The simulation replicates the forces experienced during the gait of individuals with lower-limb amputations. Ultimately, this research compiles detailed comparisons among various materials based on the established modeling parameters. In conclusion, the study's outcomes promise advancements in prosthetic design, which in turn can enhance the overall patient experience by offering increased durability and potentially more cost-effective solutions. These collective advancements significantly contribute to the progression of the orthopedics and prosthetics field.

46 Design and Study of Mechanical Properties of Carbon Fiber Based Transfemoral Socket

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

This study aims to explore the design and mechanical properties of a transfemoral socket made of carbon fiber material. Transfemoral sockets are crucial components in prosthetic limbs, providing a vital interface between the residual limb and the prosthesis. The choice of materials for these sockets significantly impacts their performance, comfort, and durability. Carbon fiber is chosen due to its properties such as high stiffness-to-weight ratio, lightweight nature, and better fatigue resistance. This study helps evaluate the suitability of carbon fiber materials as the primary material for designing transfemoral sockets and gain a deep understanding of their mechanical behavior. It also involves a comparison of its mechanical performance with other materials like titanium, acrylic resin, and polyethylene. The study begins by creating a 3D scanned model of a transfemoral socket. Finite Element Analysis (FEA) is applied to simulate various loading conditions. The main objective is to evaluate stress distribution, deformation characteristics, and potential failure modes within the carbon fiber socket model. The comparison of the carbon fiber socket model with other materials is based on stress and strain distribution under various loading conditions, deformation and deflection characteristics, fatigue resistance, and durability, including weight and density considerations. The results of this study provide detailed information on the mechanical properties of carbon fiber-based transfemoral sockets compared to other materials. Ultimately, this study aims to provide significant data for material selection in designing the prosthetic socket, enhancing the quality of life and mobility for individuals with amputations.

47 Design and Study of Mechanical Properties of Titanium Based Transfemoral Socket

Pandey, Sudeep; Goswami, Tarun
Mentor: Goswami, Tarun

This study aims to contribute to the field of prosthetics by providing amputees with an option that enhances their comfort and mobility, thereby improving their overall quality of life. However, designing a prosthetic limb for an amputee with a short residual limb presents several challenges. The primary challenge lies in the short length of the residual limb, which provides minimal room for attachment, weight-bearing, and integration. Proper socket fit, alignment, and gait mechanics need to be carefully considered. This research focuses on the utilization of titanium, a lightweight yet durable material, to construct the prosthetic limb. Titanium proves to be an excellent material for prosthetic applications due to its exceptional strength-to-weight ratio, biocompatibility, and corrosion resistance. Ansys will be employed in this proposed study to simulate a 3D rendered prosthetic designed in SolidWorks. To facilitate precise design iterations and modifications, we applied various loads in the simulation, aiming to obtain quantitative measures of stress distribution, deformation, and strain. Ultimately, this research aims to contribute significantly to the field of prosthetics by presenting an innovative approach with the potential to profoundly impact the quality of life for individuals experiencing limb loss.

48 Failure Analysis of Failed PHILOS Plate

Pandey, Sudeep; Goswami, Tarun
Mentor: Goswami, Tarun

This study investigates a failed Proximal Humerus Internal Locking System (PHILOS) orthopedic implant. These implants are utilized in the therapeutic management of long bone fractures. The examined plate in this study was a 14-hole stainless steel plate, which had broken at its midpoint. Among the nine screws investigated, one was found to be separated. Visual examination and optical microscopic images provided a detailed view of the surface scratches. Scanning Electron Microscopy indicated the presence of intermetallic inclusions and striations, suggesting fatigue crack propagation and overload failure. This study demonstrates that stress at the screw hole may have initiated the fatigue, which progressed over time with daily cyclic loading, resulting in the separation of the plate and one of the screws.

49 Long-Term In Vivo Durability and Mechanical Performance of Silicone Leads in Implantable Cardiac Electronic Devices: A Comparative Analysis and Residual Property Assessment

Salih, Anmar Mahdi Salih; Goswami, Tarun
Mentor: Goswami, Tarun

Leads are designed for in vivo applications but for a defined period. The in-vivo environment affects the mechanical behavior of implantable devices; therefore, there is a need to evaluate the residual properties of implantable leads used with pacemakers, defibrillators, and neuro-stimulators. Silicone (MED-4719) leads are widely used in cardiac implantable electronic devices manufactured by various companies. We collected 150 devices (with or without leads) from the Anatomical Gift Program at Wright State University. The objective of this study was to investigate the residual properties of Silicone (MED-4719) leads with varying in vivo exposure times and compare them to the properties of new, unused leads supplied by Medtronic for the purposes of this research. Tensile tests were performed by applying specific loads on the samples, measuring the percentage elongation at 5N, and recording the corresponding displacements. Load to failure, percentage elongation, ultimate tensile strength, and modulus of elasticity were determined for each lead. Standardized methods were employed to collect and compile data, and statistical models were utilized to assess the sensitivity of measured parameters to in vivo performance. Load to failure, elongation to failure, ultimate tensile strength, and percentage elongation at 5N showed a significant decrease after 94 months (P= 0.0063), 8 months (P= 0.0136), 94 months (P= 0.0244), and 71 months (P-value= 0.0326) after implantation, respectively. On the other hand, the modulus of elasticity was found to be proportional to the number of months the device was exposed and showed a significant increase after 71 months (P= 0.0446) in the in-vivo environment. .

50 Data Analysis of Cardiac Pacemakers

Suresh, Lohith; Goswami, Tarun
Mentor: Goswami, Tarun

Cardiac pacemakers, with approximately 1 million annual worldwide implants and about 200,000 in the USA alone, serve as critical life-saving devices. These artificial electric pulse generators deliver essential cardiac pulses, making their proper functioning paramount. Even a minor malfunction in this system can pose life-threatening risks to patients. The interrogation of pacemakers retrieved from deceased individuals offers valuable insights into device performance during the implantation period and its current state. This study aims to leverage machine learning techniques for predicting post-explantation device conditions. An AI component will play a pivotal role in forecasting device performance, advancing our understanding of these vital cardiac devices.

51 Investigation of a Deep Brain Stimulator (DBS) System

Whitestone, Jennifer Jeanne; Salih, Anmar; Goswami, Tarun
Mentor: Goswami, Tarun

A deep brain stimulation (DBS) device is a surgically implanted system that delivers electrical impulses to specific brain targets for the treatment of abnormal movement disorders. This study discusses observed aspects of in vivo damage in localized areas. The in vivo duration of the DBS device in months was estimated through multiple regression analyses of mechanical property testing from previous research on pacemaker extensions, which were coated with the same silicone material as DBS extensions. By applying these regression analyses to the test results of three DBS extensions, we estimated their in vivo duration in months. This estimation approach provides insight into the effective functioning duration of the leads before potential mechanical failure. Distortion and stretching were demonstrated in measurements of the extension coils, illustrating potential in vivo changes. These alterations may disrupt impedance, potentially reducing the effectiveness of the clinical treatment provided by the DBS system. In conclusion, this research contributes to understanding the mechanical stability of DBS leads and their operational durability, crucial for optimizing clinical treatment efficacy. The proposed model, validated through rigorous regression analyses of mechanical properties, aims to enhance the comprehension of DBS device longevity.

52 Comparative Analysis of Prosthesis Socket Materials Given Various Socket Materials and Varying Percentages of Residual Limb Length

Whitestone, Jennifer Jeanne; Goswami, Tarun; Neupane, Samikshya; Clark, Cody; Dharanikota, Ventata Gopi; Chalise, Akshay Sai; Manghe, Fidelis Obi; Pandy, Sudeep

Mentor: Goswami, Tarun

The study presented is a result of the class effort from Wright State University's graduate course in Orthopedics and Prosthetics (BME 7210). Limb amputations can result from trauma or an underlying health condition. Nevertheless, when a limb is removed, functionality needs restoration with prosthetics. Amputations performed below the knee are known as transtibial amputations. This type of amputation allows the patient to maintain knee function. However, loading on the residual limb (lower leg) is significant, as the prosthetic must bear the load during walking and other mild exercises performed by the patient. Critical to fabricating and developing a lower limb prosthetic is the fit with the shape of the lower limb and the strength of the material to withstand the load from the patient's weight and reactive forces from the foot. The objective of this modeling exercise is to analyze different types of material used for the socket based on residual limb length. The residual limb length is 50%, 65%, and 85% of the original residual length. A finite element model of the socket is developed within ANSYS and tested for strength and stress during static and dynamic scenarios. Different materials for the socket are developed by 7 investigators. Each investigator researches the physical properties of the indicated material and determines the lifespan, durability, robustness, and quantifies stress and strain within the socket. The forces applied to the simulation resemble those seen in the gait of lower-limb amputees. Ultimately, comparisons among the various materials are documented given the modeling parameters. In conclusion, the outcomes of this research encompass enhancements in prosthetic design, improved patient experiences, heightened durability, and the potential for cost-effective solutions. These collectively contribute to the advancement of the field of orthopedics and prosthetics.

53 Development of the WSU Database of Medical Equipment (DOME)

Whitestone, Jennifer Jeanne; Goswami, Tarun; Ali, Saif, Boddu, Upagna Sundari; Clark, Cody; Gowrneni, Kranthi; Hardy, Takeesha; Ireni, Poornia; Lukka, Naga Anka Kishore; Manghe, Fidelis Obi; Plaxcedes, Murawo; Palakonda, Raghavendra Rao; Pandey, Sundeep; Prashanth, Jonathan; Pandi, Kumar; Charan, Uda; Savva, Reddy; Suresh, Lohith

Mentor: Goswami, Tarun

As a comprehensive class project from Wright State University's BME 6980, the development of the Database of Medical Equipment (DOME) will be designed and prototyped to ultimately act as a global resource of medical devices for clinicians, patients, and other users. Currently, the US Food and Drug Administration (FDA) facilitates an online resource for clinicians, patients, medical device manufacturers, pharmacy companies, and curious entrepreneurs to access information regarding medical devices and medications with respect to their classification, product code, regulation number, etc. This website lists over 6,000 types of medical devices. However, there are presently millions of medical devices on the market that should be made available to the public through a "one-stop" medical database to be developed, updated, and maintained by WSU. Development of the DOME as a comprehensive database for medical equipment and devices is a complex task that involves several key components including data structure, sorting and categorization, identification system, company account creation, frontend design, and programming. The plan for DOME includes scalability using cloud-based hosting solutions like AWS, Azure, or Google Cloud while considering localization and internationalization to support multiple languages and regions. Additional features may include real-time chat support, user-generated content, and integration with healthcare standards (e.g., HL7) for global usability. Researchers, entrepreneurs, and innovators working in cutting-edge technologies and/or prototypes that may not be commercially available, but if listed in the WSU database, may provide opportunities for stimulating research and innovation. Other potential users include patients and healthcare professionals who want to explore a broader range of devices than the FDA website can provide. These users need to make the most informed decisions regarding treatment options and should have full access to the latest technologies. Additionally, education institutions, including WSU, will benefit from the comprehensive database to spark interest in furthering medical device development.

Computer Science & Engineering

54 Data-driven strategies for disease management in patients admitted for heart failure

Agarwal, Ankita; Romine, William
Mentor: Banerjee, Tanvi

Heart failure (HF) is a syndrome which occurs when the heart is not able to pump enough blood and oxygen for the body's needs. Electronic Health Records (EHRs) of patients with HF could be studied for effective disease management along with predicting outcomes like length of stay (LOS) of the patients. These outcomes should also be free from social biases to enable clinicians with fair and effective decision making. So, in this study we used longitudinal EHRs of 1200 patients admitted for HF at the University of Illinois Hospital and Health Sciences System and leveraged artificial intelligence based techniques like natural language processing, machine learning and deep learning to (1) identify the clinical phenotypes in the HF patients along with predicting the LOS using these phenotypes, (2) learn gender and ethnicity based debiased feature representations, and (3) predict the LOS of patients using these socially debiased feature representations and compare results with the biased representations. Our results show that we identified clinical phenotypes related to various perspectives about HF, which could help to study patients' profiles and discover new relationships among medical concepts. These phenotypes could be used to predict LOS of the patients with an accuracy of 61.1%. We treated this model as a baseline model. We further implemented two neural contrastive learning (CL) representation models which were (a) a biased model, and (b) a debiased model to obtain gender and ethnicity based debiased feature representations. We obtained an accuracy of 83% and 82% to predict LOS using gender and ethnicity based debiased CL representations respectively as compared to the 82% accuracy obtained with biased CL representations. So, our results indicate that our approach of mitigating social biases in the representation space did not reduce the accuracy of predicting outcomes like LOS while making socially fair predictions.

55 Improving Knowledge Graph Understanding with Contextual Views

Christou, Antrea; Shimizu, Cogan
Mentor: Shimizu, Cogan

Knowledge graphs (KGs) express structured data using entities and their relationships. This can result in highly-connected data, thus correspondingly high-level exploration tools are necessary to navigate these dense graphs. Applications for KG exploration span many use-cases: social network analysis, corporate intelligence, and medical research. Our research seeks to improve the InK Browser, a modular, web-based tool for KG exploration, by introducing the notion of flexible views. Users can select and export specific data elements in their preferred formats, facilitating data extraction. By giving users more control over knowledge graph interactions, these perspectives enhance user understanding of the KG. Flexible views are made possible by applying complex constraint definitions against data instances. When data points (and their relations) match a data shape, the flexible view provides an adaptive view of that data. The InK Browser already provides a flexible view for geospatial data (a map) and metadata (semantic and type information), as well as search functionality. We are currently working on providing KG summarization functionality through the use of dynamic shortcuts. We will assess the impact of flexible views inInK Browser-based exploration of Linked Open Data via forthcoming user-study. With flexible views enhancing personalization, we want to show how useful the InK Browser is for exploring knowledge graphs: improved discovery, improved navigation, and improved summarization.

56 Impacts of Conceptualization on Knowledge Graph Embedding

Dave, Brandon Daniel; Shimizu, Cogan
Mentor: Shimizu, Cogan

Knowledge graphs enable researchers to understand a set of data within a domain of research and how different aspects of the data may connect. The methodology used to design and develop a knowledge graph varies; however, the end result should always point back to querying for facts and truths within the data with respect to the respective domain. When designing a schema for a knowledge graph, also called an ontology, one strategy connects an entity node to pure data values represented as their data types; that is, a person has a name and that name is represented as a string. This results in a shallow perspective of the data, as the data and their relationships may be lacking significant context. Regardless, this may still be a desired approach, if there is no data of significance to describe the data values. Conversely, another approach connects graph entities in a detailed, or rich, manner. For example, a person may have a name, and the name can be split into both a given and family name, which eventually are described as their respective string representation. This approach provides a richer context that – generally – more closely mirrors reality. This work researches the impact that the complexity a knowledge graph schema has on corresponding knowledge graph embeddings, where complexity varies across shallow or rich approaches for entity-to-entity relationships. To evaluate this, we use the Deep Graph Library, which provides various embedding models. We have constructed two schemas, corresponding to the above methodologies, using CORE Scholar data provided by the WSU Libraries. Preliminary work has shown that there are indeed differences in performance, but further investigation is needed to determine the causal mechanisms, as well as to perform additional data cleaning.

57 Automated Analysis of Product Similarity

Hamilton, James Edward; Banerjee, Tanvi
Mentor: Banerjee, James

The intended application of my USAF sponsored research is creating the capability for automated analysis of supplier substitutability based on the similarity of products they manufacturer. Traditional key-word-based search tools rely on structured databases and do not exploit the rich information contained in unstructured text. This research purposes a tool that determines the similarity of unstructured text contained in the suppliers' web pages. The implementation leverages embeddings generated with a large language model (LLM), particularly a sentence transformer. The sentence transformer maps the unstructured text into a latent vector space which is then fed into a deep learning model, a Siamese Neural Network (SNN). To train and evaluate the SNN, we utilize a sample dataset within the manufacturing "castings" domain to demonstrate its feasibility. The SNN achieved an overall accuracy of 85% when evaluating the similarity of web pages from 10 product classes. In a more rigorous experiment, all positive and negative pairs were deliberately constrained to originate from different suppliers. This additional testing was aimed at reducing the possible influence of supplier similarity to ensure that only product level information was captured by the language model. The result was an overall accuracy of 82%. This tool has the potential to enable end users to rapidly search and analyze prospective suppliers that manufacture similar system components while providing an opportunity for local small manufacturers to compete with larger manufacturers to obtain contracts with government agencies.

58 Knowledge Graph to Detect the Trustworthiness of a Hardware in Supply Chain

Kandula, Rakesh; Shimizu, Cogan
Mentor: Shimizu, Kandula

The world is growing digitally in all aspects and everything is connected with a one click away. This is all possible because of two terms software and hardware, out of these two entities there is no doubt that both are important but my feeling is that hardware is more important because if the software is compromised it is a little bit convenient to fix the things by finding the malware and countering it. But things are not the same when the hardware is compromised because it is a physical entity and costs a hefty amount to replace all the hardware. Replacing hardware is nothing but to replace the entire product. This is a huge problem if the hardware is compromised and we can see the usage of hardware components in self-driving cars, electronic gadgets, IoT devices, sensors, satellites, space crafts, etc. Hardware can be compromised at multiple levels but our main focus is on supply chain. The first step in research is to collect the data of all the hardware vulnerabilities and products associated then creating a product knowledge graph and hardware vulnerability knowledge graph (KG) from the collected data. Vulnerability KG contains products and vulnerability as main entities while the Product KG consists of Products, Parts, Organization, Industrial Facility and Location as the main entities. After creation of knowledge graphs these two KGs are merged and some Knowledge Graph Embeddings (KGE) are applied on the huge single KG to predict the hardware trust. Hardware trust is predicted mainly using the Location and Industrial Facility it manufactured and additional parameters may add in future. This research extends the concept of trustworthiness to critical areas like space, defense, and confidentiality, where trust is vital.

59 Enhancing Rare Cell Type Identification in Single-Cell Data: An Innovative Gene Filtering Approach using Bipartite Cell-Gene Relation Graph

Mohammadi, Hossein; Baranpouyan, Maziyar; Mohammadi, Hossein; Gourdarzi, Torabi; Thirunarayan, Krishnaprasad; Chen, Lingwei

Mentor: Thirunarayan, Krishnaprasad

A useful tool for examining cellular diversity is single cell RNA sequencing (scRNA-seq). However, the high dimensionality and technical noise of scRNA-seq data make analysis difficult. To address this issue, gene filtering has been widely adopted to minimize single cell data noise and enhance the quality of subsequent analyses. Nonetheless, existing gene filtering techniques may inadvertently omit critical but rare genes which are necessary for identifying rare cell types that play a pivotal role in comprehending many biological processes. A novel graph-based gene selection technique is suggested in this study with the aim of preserving the informative genes to better identify rare cell types. Our findings demonstrate that this technique enhances the identification of rare cell populations, providing a refined approach for scRNA-seq data analysis and potentially enabling earlier and more reliable disease detection.

60 A Knowledge Graph-Powered Conversational Agent for Video Game Recommendations

Saini, Anmol; Shimizu, Cogan
Mentor: Shimizu, Cogan

In an era of overwhelming information access, conversational agents provide a convenient and efficient means for a user to query, navigate, and understand that information. Traditional methods, however, often lack the capability to provide context-aware responses and access structured knowledge repositories, relying instead on keywords and other language identifiers to trigger pre-written responses. Conversely, a knowledge graph-powered conversational agent could offer users more personalized and precise information by being capable of multiturn conversations that include context-aware responses and accurate information retrieval. This research explores the development of a knowledge graph-powered conversational agent functioning as a video game recommendation system. The project began with an extensive data collection phase to delineate the information in the conversational agent's schema/ontology. This data was then transformed into Resource Description Framework (RDF) triples, resulting in structured Turtle (TTL) files. These TTL files are being used to construct a knowledge graph to model and represent the data in a structured, interconnected way. The natural language understanding (NLU) component of the conversational agent will be developed next using a variety of natural language processing (NLP) techniques to ensure it accurately comprehends user input and responds in a conversational and contextually relevant manner. The potential impact of this research extends beyond the realm of video games. By illustrating the capabilities of a knowledge graph-powered conversational agent in delivering personalized, context-aware, and precise information, we demonstrate the adaptability of such models across diverse fields and industries. As our project advances, we anticipate that it will inspire further exploration of knowledge-driven conversational agents.

61 SCD Physiological Profiling: Unveiling Patient Clusters using A.I.

Somavarapu, Raj Kamal; Padhee, Swati; Kumar, Utkarsh; Abrams, Danny; Shah, Nirmish
Mentor: Banerjee, Tanvi

Sickle Cell Disease is one of the most prevalent genetic blood disorders affecting millions of individuals worldwide. Chronic pain is a common condition in SCD patients which may lead to increased medical costs, morbidity, and mortality. Prior research studies have sought to predict patients' subjective pain scores based on their physiological features. In this study, we categorize SCD patients into distinct clusters based on their vital signs. In particular, unsupervised machine learning algorithms were designed and applied to the patient dataset to find the clusters that reflect the similarity in physiological and pain profiles. This led to an in-depth analysis to uncover the unique and critical features responsible for distinguishing one group of patients from another. In particular, our study revealed the choice of four clusters to be the best fit for our patient cohort, with clusters indicating patients with unique profiles in the following physiological measures (i) first cohort indicating the presence of high heart rate, (ii) the second cohort indicating the presence of high blood pressure, (iii) the third cohort indicating the presence of a combination of low blood pressure, high respiration and high heart rates, and (iv)the fourth cohort indicating the healthiest patient cohort with values indicating lower blood pressure and high oxygen saturation values. These automated grouping can then be used to determine different relations between pain and physiology as a means to better understand pain in sickle cell disease cohort.

62 Chest X-ray Multi-Label Classification Model

Townsell, Douglas J; Banerjee, Tanvi
Mentor: Banerjee, Tanvi

The healthcare field is undergoing a dynamic transformation, marked by a growing interest in harnessing the power of Artificial Intelligence (AI) and Machine Learning (ML) to augment the capabilities of medical professionals, especially in developing highly specialized solutions tailored to address intricate challenges within the healthcare industry. Deep learning models have been harnessed to decipher anomaly features in medical images, surpassing the discernment capabilities of the human eye as well as human error in the diagnostics domain. The focal point of this research is the development of an advanced multi-label classification model i.e. the presence of more than one healthcare condition, meticulously designed to identify and classify 15 distinct chest conditions such as hernia, pneumonia among others, with remarkable precision. This model operates by analyzing X-ray images and predicting one or more pre-existing conditions the patient might have . The challenge lies in employing a well-defined threshold as its decision boundary (determining how precise the model needs to be while not increasing false positives), the model effectively determines the presence or absence of each condition within the image, offering a robust and reliable diagnostic tool. The model is currently using a threshold of 0.17, which results in an average precision score of 0.30, an average recall score of 0.59, and an average F1 score of 0.30 across all 15 classes. Such a diagnostic tool can assist in clinical decision support to address the challenging space of co-morbidities for respiratory health conditions.

Mechanical & Materials Engineering

63 Effect of Size and Shape Parameters on Microstructure and Microhardness on Additively Manufactured Inconel 718

Ahsan, Showmik; Young, Daniel; Tullis, Rachel
Mentor: Young, Daniel

Additive Manufacturing (AM) methods are promising in applications where complex part geometries, exotic materials and small lot sizes are required. Aerospace manufacturing stands to use AM methods extensively in the future, and frequently requires temperature- and corrosion-resistant alloy materials such as Inconel 718. However, the microstructural evolution of Inconel 718 during additive manufacturing is poorly understood and depends on part size and shape. We studied the microstructure of Inconel 718 parts manufactured by Laser Powder Bed Fusion in order to further elucidate these dependencies. Microstructural analysis, SEM imaging, EBSD scans and Microhardness testing were performed.

64 Additive Manufacturing for Printed Electronics

Asam, Vignesh; Mian, Ahsan
Mentor: Mian, Ahsan

Additive Manufacturing is changing the way we make things. It allows us to create custom designs and packaging for electronics that saves space and money. Today, people are using this technology to make high-performance electronics that can fit more computer chips into compact devices. This article will talk about how we can use different additive manufacturing methods to come up with new packaging ideas. We'll look at the advantages and disadvantages of these methods, including how much they cost and how strong they are. We'll also talk about how smart packaging is replacing older ways of making electronics, like epoxy molding and wire connections, with new methods like encapsulation and "ramp" designs.

65 Direct Ink Write Processing of Signal Crossovers Using Aerosol Jet Printing Method

Clark, Lucas; Ouchen, Fahima; Taylor, Thomas; Heckman, Emily; Bartsch, Carrie; Mian, Ahsan
Mentor: Mian, Ahsan

Electronics in different applications, such as in medical imaging devices, radar systems, communication transmitters, and optical drives, often require various power and signal lines to be integrated at board level. In such cases, different lines may cross over one another in three-dimensional space for efficient electronic integration. Crossovers are usually achieved by adding additional layers to a PCB. However, these additional layers increase the cost, weight, and complexity of the component. By creating a process and structure to offer board-level heterogenous integration, these factors may be reduced. RF-DC crossovers were designed and additively manufactured using an aerosol jet printer. Benzocyclobutene (BCB), a thermally curable dielectric material, and Norland Electronic Adhesive 121 (NEA), a UV curable dielectric ink, were printed as crossover materials on boards containing an RF transmission line. Electroninks 615 (EI-615), a conductive silver ink, was printed on the crossover's surface to complete the DC circuit trace. Two toolpath designs were explored to serve for the digital printing of the crossover structure. A network analyzer was used to measure the scattering parameters (S12 and S21) across the RF transmission line in X-band (8-12 GHz). A thermal camera was used to capture the heat spread across the crossover region. The ramp design resulted in a more gradual slope as expected, requiring a single print of the conductive trace while the pad design required tilting of the crossover and multiple printing sessions. The NEA 121 and BCB showed no significant changes in the S21 parameter as DC power increased; however, slight coupling occurred in both. The largest S21 difference recorded at 10 GHz was 0.339 dB. The BCB crossovers exhibited higher power handling than the NEA 121 crossovers, reaching up to 6.93 W. The maximum breakdown temperature occurred at 273.0°C in the NEA 121 and at 248.6°C in the BCB crossovers.

66 Mechanical Reliability of Strain Sensors Printed Using Additive/Subtracted Hybrid Fabrication Method

Duncan, Lemuel A; Aga, Roberto; Bartsch, Carrie; Heckman, Emily; Mian, Ahsan
Mentor: Mian, Ahsan

Due to the recent advent of additive manufacturing (AM) in creating complex geometric features, the aerosol jet (AJ) printing-based AM process is currently being explored for the fabrication of strain sensors. However, printed strain sensors have many associated unknowns which result in concerns regarding their reliability, lifetime, and dexterity. This work focuses on quantifying the reliability of printed strain sensors under standard thermal-mechanical loads while considering the effects of passivation layers. In the study, six serpentine resistive strain sensors are manufactured on two cantilevers made of FR-4 with dimensions of 25 x 140 mm. Three strain sensors are printed on each substrate using particle-free EI 615 silver ink. The method of fabrication is hybrid in nature and consists of AJ printing a layer of conductive material and selectively sintering certain regions before removing the non-sintered material with 1-dodecene solvent. The gauges on one cantilever are passivated using NEA 121, while the three gauges on the other cantilever are left exposed. The samples are subjected to the following standard thermal-mechanical loading: (i) a vibration test according to the MIL-STD-883 method 2007 Cond A. where a frequency sweep at 20 Gs from 20 to 2000 Hz and back is completed in no less than 4 minutes a total of four times; (ii) a drop tests in accordance with JEDEC standard JESD22-B111A; (iii) a high temperature soak test according to Mil-Std-883, method 1008 Cond B. where the samples are subjected to 125 °C for five intervals starting at 24 hr. and increasing by 24 hr. each trial unless failure occurs. The reliability of the devices is quantified by assessing the percent change in their gauge factors between tests.

67 Study of Fiber-Loaded Slurries for Oxide-Oxide Ceramic Matrix Composite Fabrication by Additive Manufacturing

Matondo, Gaspard; Young, Henry; Rueschhoff, Lisa; Kassner, Christopher; Wyckoff, Conner
Mentor: Young, Henry

This project aims to develop and characterize feedstock for digital light processing (DLP) additive manufacturing of oxide ceramic matrix composites (CMCs). In the DLP process, ultraviolet light is used to cure slurries through the interaction of this UV light and a UV-curable polymer phase filled with ceramic powders. While DLP has been proven to produce ceramics with complex-shaped geometries, little effort has explored the incorporation of fibers that are needed to toughen ceramics for structural components. Here, we present a summary on DLP feedstock developed using a commercially available alumina slurry with varied amounts of added oxide chopped fibers. Different characteristics such as fibers length, shear thinning coefficient and viscosity were monitored in order to obtain better printability. Single layers were printed on an Admatec DLP printer to establish a relationship between depth of cure and fiber content. Another correlation between volume proportion of fibers and surface roughness is studied. Single and multi-layer prints were debound and sintered for characterization. Relationships between fiber length and loading and the resulting sintered microstructure will be presented.

68 Processing of Silver Nanoparticle ink for Inkjet Printing

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

Inkjet printing provides a straightforward approach for creating flexible hybrid electronics devices of the next generation. It combines the creative design capabilities inherent in additive manufacturing technologies with the adjustability of functional materials and prospects for their integration into heterostructures. However, to completely exploit this potential, it is imperative to broaden the list of functional high-strength materials accessible for utilization in additive manufacturing technologies. In this article, we provide an overview of the current advancements in formulation methodologies for ink materials, techniques for customizing the functional characteristics of inks, and the integration of multiple materials in the printing process. We reviewed into the complex connections between materials, processes, and resulting properties, especially focusing on emerging functional materials such as nanomaterials, polymers, and composites. We illustrate these concepts with example of current state-of-the-art devices. Furthermore, Silver nanoparticle ink as a conductive ink is widely used for printing on flexible substrates for interconnections because of its different salient physical and chemical properties. Utilizing silver-based flexible printed electronics presents the opportunity to create cost-effective and environmentally sustainable products. So, for this study we synthesized the Ag NPs ink by using of silver nitrate, polyvinylpyrrolidone (PVP) and ethylene glycol, where these chemicals acted as metal precursor, stabilizer and reducing agent, respectively. The synthesis process is explained step by step and photos of entire process were shown. Further, for the high-resolution images and elemental identification, Ag NPs ink is characterized by SEM and EDX respectively. Keywords: Ag Nanoparticle ink; Inkjet Printing; Electronic Packaging; SEM

69 Processing Parameters, Surface Roughness, and Fatigue of As-Printed Additively Manufactured Alloy 718

Tullis, Rachel Elizabeth; Klingbeil, Nathan; Gockel, Joy; Sheridan, Luke; Celli, Dino
Mentor: Klingbeil, Nathan

The as-printed surfaces of parts produced through laser powder bed fusion are significantly rougher than surfaces produced through traditional manufacturing processes. This increased roughness can have a significant impact on mechanical properties, with perhaps the most notable detriment in the fatigue life of the part. Therefore, the as-printed surface roughness in additively manufactured materials must be studied more extensively to determine its impact on fatigue performance. This work analyzes the surface roughness of additively manufactured specimens through the investigation of contour processing parameters and their effects on surface roughness in metal additive manufacturing. Furthermore, the relationships between as-printed surface roughness and fatigue behavior in AM materials are studied using axial fatigue testing methods involving compliance initiation detection, stress intensity factor analyses, and fractography.

College of Health, Education, and Human Services

Human Services

70 Towards Culturally Responsive Scalable Mental Health Interventions in India

Hira, Nainika; Srivastava, Arushi; Palitsky, Roman
Mentor: Palitsky, Roman

Digital scalable mental health interventions have the potential to serve entire populations, meeting a vital public health need. However, the universalization of interventions risks leaving the specific needs of users unmet due to a lack of cultural competence and implementation challenges. Culturally tailored scalable mental health interventions can boost the utilization of mental health services among BIPOC communities. This poster would focus on India, where the development and implementation of culturally responsive interventions are especially needed. India's public health infrastructure is under-resourced to address its significant need for mental health services, with only 0.75 mental health professionals per 100,000 people (Garg et al., 2019). India, the most populous country in the world, boasts the second-largest number of smartphone users globally, and has become a focal point for enthusiastic investment in mental health apps. Recent Indian policies also reflect the potential of mobile interventions, including allocations for mobile mental health in the recent national budget and the launch of a national mental health app (Singh & Sagar, 2022). However, further work is needed to ensure effective, culturally responsive, scalable interventions that fit Indian populations. This poster will identify general adaptation principles and tailoring variables important for the Indian context.

Leadership Studies in Education and Organizations

71 Exploring a Relationship Between Academic Program Assessment and Student Success

Christian, Nick; Miura, Yoko
Mentor: Miura, Yoko

Recent reports confirm that US higher education is facing increased scrutiny because the public believes that college is not worth the time or expense. With an increasingly utilitarian view of higher education, the roles of university leaders and faculty are to ensure programs of study provide students with the skills society seeks. Researchers claim without empirical evidence that assessment is important to student success. Faculty are reluctant to participate in assessment activities because they do not believe the activities matter. This poster presentation will highlight quantitative research-in-progress to examine the relationship between the implementation of academic program assessment practices and student success. Structural equation modeling (SEM) methods will be employed to examine how faculty motivation, organizational learning and culture, and the implementation of academic program assessment practices combine to impact student success in four-year undergraduate institutions in the United States. The results of this research are expected to impact how institutional leaders develop cultural aspects of their institutions to motivate participation in learning outcomes assessment at the program level.

Professional Psychology

72 How Physical Movement Impacts Cognitive Achievement in Students

Lebo, Samantha; Skultety, Madeline
Mentor: Jackson, LaTrelle

Physical activity has long been taught to be beneficial to our health and wellness, however recent research has begun to detect its impact on academic performance as well (Maeda & Randall, 2003; Marques et al., 2017). Where college students may struggle with exposure to new topics and fields of study, physical exercise, primarily walking or cardio based activity, is beginning to show a statistically significant positive influence on grades in several environments (Phan et al., 2018). With a week of physical exercise, researchers in Taiwan noticed impacts on memory capacity and retention that allowed for greater flexibility on students' performance (Phan et al., 2018). Similarly, in the United States, following a mere ten minutes of exercise, memory improved for all primary aged scholars, with high schoolers also improving in mathematics performance as well (Mualem et al., 2018). While recess and general school environmental exercise has decreased over recent years, current research is reflecting a positive association between exercise and academic performance increase, which has researchers lobbying to return free play or even exercise activities to the classroom for all ages (Donnelly & Lambourne, 2011; Howie & Pate, 2012).

73 School Belonging Effect on Transgender Adolescents

Marcrum, Jessica L
Mentor: Vaughan, Michelle

In 2019, about 2% of high school students identified as Transgender (CDC, 2019). This number is likely underreported due to the safety concerns that coming out in some areas. Even so, in 2019 there were 15.1 million children in high school (Think Impact). That is roughly 302,000 adolescents who identify as transgender and are spending most of their time in school. Transgender people are more likely to face victimization and increased rates of depression and attempted suicide (Hatchel and Marx, 2018). This project aims to see if feeling like they belong at school impacts their well-being. This project integrates both affect and social components. School belonging combines effects because it could affect the teen's mood and depression. School belonging integrates social components because many transgender teens face discrimination at school. These two interact because discrimination has been shown to increase depression symptoms (Everette et al., 2016).

College of Liberal Arts

Humanities and Cultural Studies

74 Sport as Public History: My Time at the National Baseball Hall of Fame and Museum

Buchheit, Alexander
Mentor: Pollock, Sean

Public History is the act of preserving and presenting history for the general public, or gathering historical information that the public deems important. Sports are a way for the public to come together and witness history on a weekly or even daily basis. Professional baseball has been around in America for well over 150 years, and it is a story that is told 162 times every year. That gives it ample opportunity to make history within that field, from World Series winners to individual feats of hitting, fielding and pitching. All of this information is found within the National Baseball Hall of Fame and Museum, the institution that I interned at as the Frank and Peggy Steele Curatorial Intern for 2023. In this presentation, I will demonstrate what curators do at the National Baseball Hall of Fame and Museum to preserve sport history for the thousands of diehard fans that make the pilgrimage to Cooperstown, NY every summer to witness and interact with history they deem valuable. This includes research of artifacts, writing labels for display artifacts and giving tours of the collection to visitors. The main purpose of this presentation is to highlight the fact that the sport of baseball and its history is integral to the story of American history, not because it is a political movement or a war, but because men and women who played baseball contributed to the growth of American culture in a way that only a handful of other things can claim to do so as well.

Social Sciences & International Studies

75 A Winning Effort: What prepares Public Administration students to enter Local Government?

Bingaya, Angela
Mentor: Warshawsky, Daniel

A fragmented government is characterized as a system of several governing subdivisions, sharing power within a single area. In modern times, local government within the United States has become increasingly fragmented with over 90,000 distinct local governmental units existing throughout the country. Local governments within the U.S primarily function through the hands of both politically elected and appointed public administrators. These administrators are qualified to work in local government, usually by way of obtaining an academic degree in public service (e.g., public policy, public administration, and public health) and they are heavily relied upon to deliver and provide essential services for the citizenry (e.g., public works, transportation, and public safety). While fragmentation of government is neither inherently good or bad, fragmentation within the local government is often associated with negative impacts that affect its consistency and efficiency. Due to heightened dependency on local government among citizens, it is imperative that administrators are educationally prepared with specialized skills that stretch beyond the idyllic project management, leadership, or policy analysis skillset (that would be sufficient for working in any sector of society). However---as it concerns the preparation of graduating public administrators---research is limited in regard to what these specialized skills are. For this reason, this work seeks to identify and articulate the abstract skills that must be emphasized upon, in preparing public administration students to be effective within a fragmented local government.

76 Que lisent les Français ? Une étude de littérature française ultramoderne / What are the French Reading? A study in ultramodern French literature

Bolin, Kaycie R
Mentor: Halling, Kirsten

What are contemporary French readers choosing to read? It's no secret: the French love books. For centuries, literature has been a source of national pride. We can look at the list of Nobel Prize winners for literature for an example of this love. As of 2022, French writers have won the Nobel Prize for Literature sixteen times. In 2019, “The American Library in Paris” published an article with impressive statistics: 88% of French people consider themselves readers, and 92% have read at least one book in 12 months. In terms of reading, France is ahead of many countries, including the United States. This project explores four French books published within the last six years, and aims to uncover a portion of contemporary French culture, to reveal thoughts, anxieties, mindset, and more.

77 Redlining and Toxins in Dayton, Ohio

McCain, Dana
Mentor: Warshawsky, Daniel

The Home Owners' Loan Corporation was established in 1933 to avoid homeowners defaulting on their mortgages during the Great Depression. There was a series of maps created by the Home Owners' Loan Corporation to capture the trend of high foreclosure rates across cities in the United States. In Dayton, Ohio, neighborhoods considered "hazardous" in the 1930's have been disproportionately affected as cities develop. The goal of this study is to identify a possible correlation between these historic maps and the environmental hazards. The Environmental Protection Agency maintains the Toxics Release Inventory. This inventory tracks toxic chemicals that may pose a threat to human health and the environment. By mapping the coordinates of companies releasing hazardous material and the map of Dayton created by the Home Owners' Loan Corporation, I found there was not a strong correlation. However, upon mapping fair or poor health rates from the Centers for Disease Control and Prevention and the coordinates of companies releasing hazardous material, there was evidence that neighborhoods once considered "declining" and "hazardous" are intertwined with the present-day health of Dayton residents.

78 Affective Responses to TikTok Opinion Leaders

Sturdevant, Autumn
Spirek, Melissa

The Congressional Hearings as to the impact of TikTok on teens and young adults in the United States during the spring of 2023 generated international interest. What was unique with this research topic is that both US political parties were in agreement that they are concerned as to the impact TikTok content has on users' affective responses. This research proposal is an experiment design to address some of the Congressional and Surgeon General's concerns raised with US young adults' affective responses TIKTok use. Specifically the proposed experiment builds upon Dr. Melissa Spirek's psychophysiological responses to mediated messages as they relate to dopamine and epinephrine levels.

College of Science & Mathematics

Biological Sciences

79 Developing a Host Targeted Anti-Adenoviral Molecule

Bhandari, Suvechha; Kolawole, Abimbola O.
Mentor: Kolawole, Abimbola O.

The strong interaction between a pathogen and its appropriate receptor is vital for infection to occur. Any interruption in this complex can potentially attenuate pathogen infection. Adenovirus is a human pathogen that causes cold like symptoms in healthy individuals, which could be lethal in pediatrics and the immunocompromised. In polarized epithelia, adenovirus uses the eight-exon isoform of the Coxsackievirus and Adenovirus Receptor (CAREx8) on the apical surface, to facilitate infection. CAREx8 protein expression level is regulated by the scaffolding protein MAGI-1, using two of its PSD95/Dlg-1/ZO-1 (PDZ) domains: PDZ2 and PDZ4. We previously showed that CAREx8 is degraded after interaction with PDZ4 and rescued following interaction with PDZ2. We thus hypothesized that blocking the interaction between CAREx8 and PDZ2 would increase degradation of CAREx8 and, consequently, decrease adenovirus infection. Therefore, we developed a PDZ2 binding decoy peptide. We then synthesized six different cell penetrating peptides (CPP) at the N-terminus of the decoy peptide for easy delivery into cells. In comparison to a scrambled control peptide, all six CPP reduced CAREx8 expression level in MDCK cells that stably expressed human CAREx8. However, only three CPP significantly reduced adenovirus-5 transduction in the MDCK cells. Our data suggest that CPP conjugated to MAGI-1 PDZ2-binding decoy peptides may serve as novel antiviral peptides for adenovirus. Our plan is to investigate the effects of these peptides on CAREx8 expression in well-differentiated primary human airway epithelia and measure the level of adenovirus attenuation in vivo.

80 Evaluating the Pathways of Human Astrovirus Egress from Infected Cells

Daniels, Salina Denee; Eduful, Joshua; Kolawole, Abimbola O.
Mentor: Kolawole, Abimbola O.

Human astroviruses (HAstVs) are the third major cause of viral gastroenteritis in pediatric patients, the elderly and immunocompromised individuals. HAstVs are highly prevalent non-enveloped positive sense RNA viruses. There are currently three recognized clades of human astroviruses. These are classic, MLB-type and VA-type. However, little is known about the transmission, immunity, replication, and epidemiology of these viruses. Reports have suggested that during HAstV infection in cell culture there is no evidence of robust cytopathic effect thereby making the enumeration of infectious particles by plaque assay impossible. This phenomenon led us to investigate the possible pathways HAstV egress from infected cells. First, we studied the role of cell lysis in HAstV release. To accomplish this, we evaluated cell death in HAstV infected Caco2 and Huh7.5 cells by trypan blue exclusion staining, WST-1 assay for cell proliferation and Annexin V/propidium iodide staining for cell apoptosis using microscopy and flow cytometry. Intriguingly, HAstV-1, MLB-2, and VA-1 did not show significant cytopathic effect in infected cells despite the multiple log increases in viral titer as determined by RT-qPCR. Next, we investigated the role of extracellular vesicles (EV) in HAstV release. Using pharmaceuticals to modulate EV synthesis, we found that HAstV release increased when Forskolin and Norepinephrine were used to enhance EV production in infected Caco2 and Huh7.5 cells. Conversely, inhibition of EV production by GW4869 significantly reduced HAstV release in infected cells. Additionally, EVs isolated from infected cells supportss new infection without trypsin activation. Our data showed an association between EV produced by host cells and the released HAstV particles. This suggests that human astrovirus egress is non-lytic and may involve the use of EV.

81 Quantifying Structural and Functional Root Traits and their Effects on the Root Microbiome

Greene, Madeline; Rúa, Megan
Mentor: Rúa, Megan

Forests are globally dominate ecosystems, occupying approximately 30-40% of vegetated land area. Forest ecosystems are home to economically important plant species which depend on a suite of microorganisms to promote plant growth, defend against pathogens, and cycle nutrients. However, there is a lack of understanding as to what drives changes in the microbial assemblage of individual trees and how that connects to root trait expression. As plant-microbe interactions may range from symbiotic to parasitic with commensurate outcomes for plant health, it is important to understand the driving factors behind microbial community assemblage and how root traits impact changes in microbial presence within the root microbiome. Root traits are the phenotypic variations within a root structure that capture elements of plant health, response, and function. Functional root traits, like root carbon concentration (RCC) and root nitrogen concentration (RNC), measure nutrient cycling efficiency. Structural root traits, like root mass fraction (RMF), illustrate the allocation of nutrient resources to the belowground root structure. Ultimately, plants seek to fulfill their nutrient needs in the most efficient manner and will deploy roots with high RNC which release nutrients into the soil to attract microbial partners, thereby providing necessary nutrients at less of an expense to the plant. In doing so, these plant-microbe connections may stimulate root growth, which increases RMF, thereby creating additional locations for microorganisms to colonize. Using a plant model system (Pinus radiata), we will measure changes in the root microbiome as a function of changes in the RNC, RCC, and RMF. We hypothesize that colonization will increase on roots with high RNC and RMF but decrease with low RCC and RMF. These results will contribute to building a better understanding of how root traits influence plant-microbe interactions within the root microbiome, leading to improved plant growth and health for forest ecosystems.

82 Investigating the Role of Clonal Interference on Norovirus Resistance to Neutralizing Antibody

Khadgi, Riya Kiran; Kolawole, Abimbola
Mentor: Kolawole, Abimbola

Viruses with RNA genomes are prone to mutations during replication. This is due to the inability of RNA polymerase to correct replication errors. Such a high mutation rate has enabled RNA viruses to develop resistance to antivirals including vaccines and neutralizing antibodies. Human Norovirus belongs to the family of Caliciviridae, which is a non-enveloped, positive-sense single-stranded RNA virus. It is one of the major causes of acute gastroenteritis worldwide and several diarrheal diseases. Murine norovirus (MNV) is used as a surrogate to study norovirus biology in the lab because MNV is easily culturable. At least 3 neutralizing monoclonal antibodies (mAbs) have been developed against MNV-1 (murine norovirus 1) to study how the virus evolves to develop resistance against the mAbs. According to recent theories, mutations inserted at certain sites other than the antibody binding site can modify the capsid's actual binding site and result in neutralization resistance. Although it has been reported in multiple viral species that resistant viruses can protect susceptible viruses of the same species from antibody neutralization by a process of clonal inference, it has never been reported in MNV. Therefore, we are investigating the phenomenon of clonal interference in MNV. To do this, we mixed the susceptible and resistant virus in different proportions before infecting RAW 264.7 cells with the virus mixture in the presence of neutralizing or non-neutralizing antibody up until 5 passages. After every passage, we performed RNA extraction, RT-PCR, PAGE, and DNA Sequencing to evaluate the percentage of protection the resistant virus offered the susceptible virus. We are currently analyzing our data to determine the existence of clonal interference in MNV.

83 Avian Influenza Emerges with Fractal Patterning

Lee, Ellen E; Barton, Christopher
Mentor: Romine, William

Avian influenza (H5N1) has rapidly become a concern to human health due to the virus' nature of adapting to new hosts. In 2022, the virus was shown to morph from a disease spread only by birds, to one that can potentially be spread from mammal to mammal (Middlemiss, et al. 2023). As we continue to examine the 2022-2023 H5N1 outbreak, patterns have emerged from both the dates of the outbreaks, and the patterns within migratory bird flight corridors within the United States. Utilizing fractal pattern functions first discovered by Dr. Benoit Mandelbrot, we have been able to analyze the data here represented by a cantor dust and Levy flight pattern (Mandelbrot, 1982). These analyses can be utilized to predict future patterns of outbreaks which may lead to better preparation for flock handlers, thus reducing the number of birds killed as a result of contracting the virus. Additionally, our analyses may be able to help bolster vaccination of mammals (including humans) against influenza who are in areas of high impact.

84 Identifying the Taxonomic Composition of Forest Soil Viral Communities in Response to Elevated Phosphorus and pH

McLaughlin, Anthony Christopher; DeForest, Jared; Rúa, Megan
Mentor: Rúa, Megan

Temperate forests are invaluable ecosystems, offering a multitude of resources while playing a pivotal role in global carbon sequestration and climate regulation. Within these forests, the soil serves as a critical backdrop for numerous organisms. Earth is abundant with viruses; current estimates suggest a staggering 4.80 x 10^31 phages globally. Approximately 10% of these inhabit soils, marking them as significant repositories for terrestrial viruses. Soil viruses have been identified as influential factors in nutrient cycling and microbial community dynamics within these forests. They achieve this by infecting microorganisms, driving nutrient turnover, reprogramming host metabolism, and containing genes essential for carbon, phosphorus, and nitrogen cycling. However, despite their evident importance, the adaptive responses of soil viruses to variations in soil nutrient dynamics, particularly pH and phosphorus levels, remain ambiguous. Addressing this gap, this study aims to investigate the impact of pH and phosphorus on soil viral communities within forested environments. Specifically, we will examine the composition, diversity, and abundance of soil viruses in a long-term field experiment where pH and phosphorus levels have been factorially manipulated over a span of 13 years. We expect that elevated phosphorus levels and increased pH, will lead to a greater viral diversity. Furthermore, We predict these alterations will induce significant changes in the soil viral community composition. Gaining a deeper understanding of the relationship between soil viruses and temperate forests not only holds the key to enhancing soil fertility but also amplifies our capacity to reinforce ecosystem functions and elevate conservation methodologies.

85 Incidence of the Virus Causing Newcastle Disease in Southern African Waterfowl

Murphy, Emily; Peters, Jeffrey L.
Mentor: Peters, Jeffrey L.

Newcastle disease is caused by avian paramyxovirus type-1 (AMPV-1) and has a high morbidity rate, and therefore, greatly affects the poultry industry worldwide, including southern Africa. Transmission is caused by ingestion or inhalation of the virus. Due to the method of transmission, waterfowl and migratory birds are susceptible to infection, even though most are asymptomatic. We conducted a retrospective study of infection rates of waterfowl at sites in Botswana, South Africa, and Zimbabwe. The goal of this study was to determine whether infection rates differed between locations and species. Samples (n=480) were screened using PCR for two AMPV-1 genes, the Fusion gene and the Matrix gene. Samples were then assessed for the presence of bands using gel electrophoresis; the presence of a band indicated the individual was positive for an infection, whereas the absence of a band indicated no infection. Infection rates varied between locations, with the highest infection rates at both sites sampled in Zimbabwe (36.4% and 19.5%). Infection rates tended to decrease moving southwards. Infection rates also varied by species with the highest infection rates being in the Cape Shoveler (50%), White-faced Duck (31.8%), Cape Teal (25.7%), and Red-billed Teal (24.7%). The lowest infection rates were found in the Egyptian Goose (9.3%) and the Spur-winged Goose (5.9%). These data demonstrate variable infection rates across the landscape and among taxa; however, given that the composition of the avian community varied across the landscape, the results are confounding. Future work will involve screening additional samples to disentangle the influence of geography and biodiversity on infection rates.

86 Effects of Chronic Hypercarbia on Morphological and Ventilatory Development in Crayfish

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

Instances of abnormally high CO2 levels are becoming increasingly common in freshwater ecosystems undergoing eutrophication, causing a long-term increase in CO2 (chronic hypercarbia). Higher CO2 partial pressure is believed to increase the ventilation and metabolism of aquatic organisms and hinder their morphological development in acute doses. To quantify the degree to which chronic hypercarbia alters the ventilation and morphology of freshwater organisms, crayfish have been reared in chronic hypercarbic water equilibrated with 5% CO2. The morphological effects of chronic hypercarbia on crayfish are shown with body mass, length, and width measurements, while ventilatory rate measurements exhibit the impact on ventilation.

87 Human Astroviruses Infection Modulates Aquaporins Production in Vitro

Robinson, Makalia Taylynn; Daniels, Salina D.; Kolawole, Abimbola
Mentor: Kolawole, Abimbola

Human astroviruses (HAstV) are non-enveloped, positive sense single-stranded RNA viruses. These viruses are categorized into classical and nonclassical astroviruses. Classical HAstV are known to cause diarrhea in children, the elderly, and immunocompromised patients. However, the mechanism underlying HAstV-induced diarrhea remains unknown. Additionally, the etiology of nonclassical HAstV has not yet been reported. Although, recent studies have implicated the nonclassical HAstV in neurological diseases of immunocompromised patients diagnosed with acute encephalitis. In response to osmotic gradients, a family of integral membrane proteins called aquaporins (AQPs) transports water across the cell membrane. Due to the highly selective permeability of the cell membrane, AQPs are essential in the mobility of water. Excessive water loss is a typical symptom of HAstV-induced diarrhea. Thus, AQPs may play crucial roles in virus-induced diarrhea. In this study, we examined the expression of all thirteen human AQPs (AQP 0-12) in two cell lines (Caco-2 and Huh7.5) used to propagate HAstV. Our results showed that the effect of virus infection on AQP expression was largely dependent on three variables which included: duration of viral infection, virus serotype, and the specific cell line. Astrovirus infection significantly increased the expression of AQPs 3, 8, and 10 up to 3 days post-infection, suggesting that AQPs may play a role in HAstV-induced diarrhea. However, further investigation is required to determine the specific roles due to the variability in cellular expression of AQPs.

88 ALS-associated Matrin-3 Increases Cell Size in the Yeast Model

Shah, Rahul M.; Ghouse, Fawaz; El-Zein, Widad; Zhong, Quan; Ju, Shulin
Mentor: Jun, Shulin

Amyotrophic Lateral Sclerosis (ALS) is a fatal neurodegenerative disease resulting from motor neuron death. MATR3 is a gene that leads to cytotoxicity when mutated in motor neurons. It codes for Matrin-3, a nuclear matrix protein that binds to DNA and RNA. Matrin-3 mislocalizes from the nucleus to the cytoplasm when mutated and forms aggregates. Using a yeast model to study MATR3, we found an increase in cell size with increasing Matrin-3 toxicity. Suppressor genes that rescue Matrin-3 toxicity, when overexpressed, have been previously identified through a genetic screen of thousands of human genes. To determine the association of cell size with Matrin-3 toxicity, we are using the suppressor genes that rescue Matrin-3 toxicity and checking whether they reverse the increase in cell size.

89 Quantifying Changes in Root Architecture in Response to Increases in Soil pH and P

Slaughter, Mariah.; DeForest, Jared; Rúa, Megan

Forests cover approximately 30% of Ohio and contribute $434 million to the state's economy. One of the drivers for forest productivity is soil nutrient dynamics which alter plant root growth. For example, roots with higher branching intensity have more surface area for nutrient uptake while roots with lower diameters can better perforate the soil to seek out nutrients. Consequently, changes to soil nutrient economies can influence tree growth potential such that we expect to see shifts in root foraging strategies to better mine nutrients as soil chemistry and nutrient availability change. To evaluate the potential for shifts in root foraging strategies following changing soil nutrient economies, we quantified changes in root architecture of two focal tree genera, Quercus and Acer, in response to elevated soil pH and phosphorus (P) within a 13-year study in the unglaciated Allegheny Plateau. We harvested terminal tree roots of focal species then washed and scanned roots using the root quantification software WinRHIZO™ (Regent Instrument Inc.) which generates estimates of root thickness and branching intensity. Preliminary results across genera showed root branching intensity significantly increased by 18.3% compared to ambient soil when both soil pH and P were increased ($F_{3,224.21} = 9.81$, $p < 0.001$); however, root diameter was not significantly affected by changes in pH, P, or their interaction ($P>0.5$). These findings suggest that changes in soil chemistry may alter root foraging strategies that increase root surface area as nutrient availability changes. Over time, these changes could alter forest communities as some tree genera more effectively mine limiting nutrients from the soil than others. The results presented here contribute to a better understanding of the effect that changes in soil chemistry on the belowground tree system, which may be key in determining which tree genera are able to survive altered soil conditions.

Chemistry

90 Heavy Metal Detection Utilizing Electrochemical Sensor

Andoh, Papa Kofi Damte
Mentor: Lunsford, Suzanne

This research focuses on an electrochemical sensor to detect heavy metals. As part of the sensor-creating process, nanoparticles are synthesized and used to enhance the detection capability of these electrochemical sensors. 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 Greener synthesis method which involves the use of clean, safe, cost-effective and environmentally friendly substances as well an 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 and cadmium and also 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. These studies are successful with the development of a selective electrochemical sensor to detect Pb and Cd simultaneously without the need of prior separation.

91 Assessing the Ion-Selective Electrode Method for Investigation of the Pathway for Formation of Calcium Fluoride

Crone, Courtney Lynn; Peterson, Brent
Mentor: Higgins, Steve

Calcium fluoride, which naturally occurs as the mineral 'Fluorite', is the world's most abundant source of fluorine, yet there have been limited studies on its nucleation mechanism. Previously, mineral nucleation, including that of fluorite, was described by classical nucleation theory (CNT), a theory which is based on the thermodynamic properties of bulk materials. However, an alternative model, known as non-classical nucleation theory (NCNT), has been increasingly used to describe nucleation of minerals. This model considers the presence of thermodynamically stable ion clusters known as "prenucleation clusters" (PNCs). In this experiment, the nucleation mechanism of calcium fluoride was investigated to identify evidence of PNCs by means of the ion-selective electrode (ISE) method. The ISE potential was recorded versus calcium dosed, from which the number of free calcium ions in solution could be determined. Despite previous publications reporting evidence of PNCs using ISE potentiometry, it was discovered in the development of the titrimetric procedure that the method was influenced by uncontrolled environmental variables, such as temperature and pH. The effects of these variables, if not controlled to within certain limits, may give the appearance of ion clustering and therefore lead to incorrect conclusions on the formation of PNCs.

92 Developing a Method for Spectrophotometric Determination of Strontium Complexation with Methylthymol Blue

Djanman, Adebayo Comlan
Mentor: Higgins, Steve

Investigating how strontium (Sr) binds to methylthymol blue (MTB) is a crucial research project with environmental and analytical implications. Strontium needs in-depth research because it is present in radioactive waste streams, natural water, and it is used as a tracer in geological and biological processes. This study aims to investigate the nature of the complex formed between MTB, a well-established metallochromic indicator, and Sr. Also, this research seeks to determine essential parameters including the stoichiometry of complexation, the formation constant, the maximum absorption wavelength for the MTB:Sr complex, and the absorptivity coefficient of the complex. Using UV-Visible absorption spectroscopy, MTB was characterised as a function of solution pH. In a MTB solution, increasing the pH causes deprotonation, resulting in a bathochromic shift at 430 nm in the absorbance spectra. In addition, an increase in absorbance is observed at 610 nm with increasing pH. Future experiments will investigate the influence of pH on MTB:Sr complex formation. This abstract highlights the research aims and methods as the experimental data for the MTB:Sr complex is still pending. However, the results of this study will offer scientific insights into the interaction between MTB and Sr, which can be applied in different fields such as environmental sensing and analytical chemistry.

93 Using Antioxidants to Synthesize Metal Nanoparticles To Be Used As Possible Sensor To Detect 1,2-dihydroxybenzenes Electrochemically

Mikusa, Mikusa; Boateng, Lawrence A.; Andoh, Papa Kofi Damte
Mentor: Lunsford, Suzanne

The synthesis of metal nanoparticles such as silver nanoparticles (AgNPs) was the focus of this project using green synthesis techniques. Conventional synthesis steps are under scrutiny due to the use of toxic chemicals in their production and hazardous by-products. Green synthesis techniques for such assembly of AgNPs include the use of plant extracts, or fruit extracts. These extracts are novel, greener and cost-effective can be used as capping as well as reducing agents in the synthesis of nanoparticles (AgNPs). The synthesis of metal nanoparticles (AgNPs) were carried out using antioxidants turmeric extract and pomegranate extract. Tumeric (Curcuma longa L.) has been used as a spice and medicinal herb, and the main active ingredient of Tumeric is curcumin. Curcumin is a polyphenol that helps prevent and control neurological, respiratory, cardiovascular, metabolic, inflammatory and autoimmune diseases and some cancers and Punica granatum (Pomegranate) known for richness in polyphenols as well. The nanoparticles were characterized by UV-Visible spectroscopy. The green synthesized metal nanoparticles were studied to enhance the electrocatalytic ability of the working carbon electrode to detect common 1,2-dihydroxybenzenes electrochemically. Future studies will involve analyzing the stability of the modified nanoparticle electrode under the presence of common interferences.

94 Molecular Scale Highways for Protons: Poly(Arylene Ether)s with Pendant Sulfonic Acid Groups

Reed, Austin; Fossum, Eric
Mentor: Fossum, Eric

Sources of power are ever evolving, and the energy derived through Hydrogen Fuel Cells (HFC) is positioned as a unique contender for humanity's electricity needs. Contrary to more traditional sources producing carbon dioxide or nuclear waste as a byproduct, hydrogen power results only in clean water and energy. Unfortunately, several factors currently hold back the widespread adoption of HFCs, specifically the cost. At the heart of a fuel cell is a specialty polymer that enables the whole process to take place: the Proton Exchange Membrane (PEM). The current industry standard for the PEM is Nafion, which features expensive fluorocarbons that exhibit decreased performance at temperatures above 80 °C, thereby limiting the fuel cell's operating range. Much global research currently focuses on developing better performing materials and lower cost alternatives for use in PEMs. The work of this project seeks to develop a series of sulfonated poly(arylene ether)s with unique geometry that is anticipated to improve a number of critical characteristics of PEMs, namely increased proton conductivity, lowered water uptake, and extended membrane lifetime. The project features the synthesis of sulfonated and non-sulfonated variants of 2,4- or 2,6-diflourodiphenylsulfones (DFDPS). The sulfonated versions serve as the proton conducting units in the membrane and are designed to confirm the importance of the geometry in the new pendant- vs historically backbone-sulfonated systems. This presentation will focus on the DFDPS monomer syntheses, their characterization data, and outlines the future work necessary to prepare the final PEM systems. Successful completion of this study has the potential to bring the widespread application of hydrogen power one step closer to reality.

95 Green Synthesis Technique to Modify Working Electrode with Nanoparticles to Detect Neurotransmitters

Rush, Riley H.; Crockett, Mark; Shuler, Ryan; Lunsford, Suzanne
Mentor: Lunsford, Suzanne

The electrochemical behavior of 1,2-dihydroxybenzenes such as catechol and dopamine is responsible for many important functions in the brain. Due to many nondegenerative diseases resulting in catecholamine disruption, identification of the cause of disruption among neurotransmitters such as catechol is very important to the early diagnosis. Electrochemistry has become a fundamental sensing method for monitoring neurotransmitters in live patients. Green synthesized nanoparticles deposited onto working electrodes are studied in the detection of catechol in the presence of common interferences such as ascorbic acid (AA). In addition to nanoparticles, polyethyleneimine-copper/silver nanoparticles were tested to see the relative effectiveness against the copper/silver nanoparticles on their own. The use of Differential Pulse Voltammetry as an electrochemical technique to study the reactivity in potential differences between the common neurotransmitters in the presence of AA interference will be utilized without the need for prior separation with the modified nanoparticle working electrode.

96 Synthesis of Tetrathiafulvalene fused N-Heterocyclic (TTF-NHC) Compound as Redox Active Metal-Free Organic Material for the Redox Flow Battery (RFB)

Sampath, Kalpana; Arumugam, Kuppuswamy

The technology of modern renewable energy systems and energy storage devices must improve to meet rising global energy demands and the decreasing conventional energy sources. However, current technologies are insufficient to meet common demands such as power, renewable energy, consumer electronics, and mobility. The development of battery technology is crucial for unlocking the immense potential for growth and advances in electric vehicles (EVs), electronic devices, and battery storage for renewable energy. The need for new sustainable battery technology with improved device performance is pivotal. Redox flow battery (RFB) can be utilized as electrochemical storage of intermittent renewable energy for large-scale purposes. The energy density of RFB still needs to be increased to achieve better efficiencies. The use of redox-active organic materials enables sustainable practices and greener fingerprints in battery technology. Tetrathiafulvalene (TTF) is one such stable sulfur-containing heterocyclic organic compound capable of undergoing multiple one electron reversible redox transformations. This work aims to synthesize TTF with N-heterocyclic compound such as benzimidazole, and it is expected to behave as an excellent electrolyte, having the properties of both redox active mediator and an ionic liquid. It helps to overcome limitations such as reaction kinetics and energy density, which eventually help to achieve better efficiencies in RFB.

97 Synthesis and Characterization of Gold (Au) Complexes with Newly Designed Nitro-functionalized Naphthoquinone-based NHC for Cancer Therapeutic Applications

Mudiyanselage, Dilsha Samanali Wickramasinghe Wickramasinghe; Arumugam, Kuppuswamy
Mentor: Arumugam, Kuppuswamy

Less toxicity and enhanced selectivity of gold-based compounds have proven themselves as suitable replacements for platinum-based complexes like cisplatin. Recently, our group developed dual-targeting gold(I) complexes containing naphthoquinone moieties for therapeutic applications. Therefore, it is desirable to study the behavior of gold complexes in the path to designing new cancer therapeutics. The ability to tune electronic and steric properties through various substitutions led to the study of functionalized naphthoquinone annulated NHCs. Newly designed NHCs were ligated to Iridium to study their solubility and electrochemical properties. Synthesis followed by characterization is achieved by using NMR, mass spectrometry, X-ray diffraction, cyclic voltammetry, and FT-IR spectroscopy.

Neuroscience, Cell Biology and Physiology

98 Does zinc deficiency promote renal inflammation?

Barrett, Hannah E; Rockwood, Jananie; Wenegieme, Tara-Yesomi; McMichael, Kelia; Hasrat, Khanzada; Waite, Aston; Nshuti, Adeline; Elased, Dalia; Williams, Clintoria R.
Mentor: Williams, Clintoria

Background: Renal inflammation is implicated in the pathogenesis of Chronic Kidney Disease (CKD) and plays a critical role in kidney damage. CKD-associated kidney damage stimulates the secretion of proinflammatory cytokines (e.g. IL-1β, IL-6, and TNF-α) which expedites CKD progression, further instigating kidney damage and inflammation. Studies have shown that zinc deficiency (ZnD) elevates oxidative stress and enhances proinflammatory cytokine abundance in the kidney. Based on these findings, we hypothesize that ZnD will promote renal inflammation. Experimental Design: To examine if ZnD promotes renal inflammation, wild-type adult mice (C57BL/6J) were placed on a zinc-adequate (ZnA) or zinc-deficient (ZnD) diet for 10 weeks. At week-8, a subset of the ZnD mice were returned to a ZnA diet (ZnR) for 2 weeks. To assess morphological changes and proinflammatory cytokine abundance, kidneys were isolated and processed for immunohistochemistry and immunofluorescence. Study Objectives: In this study, the objectives are to investigate whether ZnD kidneys (1) present with abnormalities in morphology and (2) have changes in abundance of proinflammatory cytokines. The localization of pro-inflammatory cytokines will also be assessed. Additionally, we will investigate (3) if zinc repletion mitigates zinc deficiency-induced renal damage and inflammation. Significance: Collectively, this study will explore (1) Zn's anti-inflammatory properties and (2) the impact of zinc repletion on inflammatory damage. If our hypothesis is correct, this study will advocate for zinc supplementation as a plausible therapeutic strategy for CKD.

99 Endoplasmic Reticulum Stress Induces Axon Initial Segment Shortening in Diabetic Conditions?

Chisholm, Amanda Marie; Shelby, Jennae; Chisholm, Amanda; Akhmedov, Islam; Griggs, Ryan; Susuki, Keiichiro

Mentor: Susuki, Keiichiro

Type 2 diabetes is an increasingly prevalent metabolic disorder highly associated with cognitive impairment. To develop more effective treatments for these neurological complications, a greater understanding of the underlying mechanisms is required. Our lab seeks to elucidate those mechanisms by focusing on the neuron's axon initial segment (AIS). This specialized region at the beginning of the axon takes incoming signals from dendrites and produces the action potential that is passed to the next neuron. 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 its mechanism remains unknown. Endoplasmic reticulum (ER) stress has been implicated in the pathophysiology of diabetic brain complications. The ER, responsible for synthesizing and folding proteins, becomes stressed by excessive misfolded proteins. This triggers the unfolded protein response (UPR) pathways: PERK, IRE1, and ATF6. Treating mouse cortical neuron cultures with methylglyoxal, a toxic glucose metabolite elevated in diabetes, induces ER stress as well as AIS shortening. Here we show exposure to both methylglyoxal and ER stress inhibitor, sodium phenylbutyrate, prevents AIS shortening in cultured neurons. Furthermore, AIS shortening occurs in cells treated by tunicamycin, a known ER stress inducer. These findings implicate ER stress as a mediator of AIS shortening. To determine a more detailed mechanism, ongoing work will identify the specific UPR pathway mediating AIS shortening. Preliminary data suggests that inhibiting the first step of the PERK pathway of the UPR with the drug GSK2606414 prevents AIS shortening. Future studies will test if inhibiting the PERK pathway ameliorates AIS shortening and cognitive impairment in type 2 diabetic mice. Our results will identify the PERK pathway of the UPR activated by ER stress as the potential target for treatment mitigating cognitive impairment in type 2 diabetes.

100 Wastewater surveillance predicts coronavirus and enteric virus trends

Cruse, Lindsey N.; Paul, Teresa; Kolawole, Abimbola
Mentor: Kolawole, Abmibola

Wastewater-based epidemiology (WBE) is a technique utilized for many applications such as determining if chemicals, metabolites, or pathogens are present in wastewater samples. In addition, multiple viruses have been shown to be shed in human feces. The goal of this study is to surveil dormitory wastewater at the Dayton and Lake campuses of Wright State University for the presence of viral genomes as a possible early indicator and to identify any relationships between the positivity of samples with events or time of the year. Wastewater samples were screened for the presence of coronavirus and a total of fourteen enteric viruses including hepatitis A and E virus, parechovirus, classical human astrovirus, astrovirus VA1, MLB1, and MLB2, influenza A and B virus, sapovirus, adenovirus, human norovirus, rotavirus, and Aichi virus. Using a portable autosampler, wastewater was collected twice weekly at five different locations. RNA was then extracted from the samples, followed by the detection of viral genomes using a multiplexed RT-qPCR system. Our data showed sporadic detection of approximately half of the viral genomes in wastewater samples obtained from different sampling points. Additionally, coronavirus and astrovirus were the predominant virus genomes detected. In summary, this method provides an efficient means for the risk assessment of virus infection.

101 Altered Proprioceptor Sensory Afferent Morphology After Sciatic Crush Injury

Grant, Delaney Christine
Mentor: Ladle, David

Traumatic peripheral nerve injuries (PNI) are caused by various injuries, including motor vehicle accidents and combat-sustained injuries. Recovery is slow, and complete recovery requires reinnervation by somatosensory and motor axons; however, there are often persistent deficits in sensory function after recovery. The recovery of proprioceptive sensory afferents and the mechanisms underlying their impaired function after injury remains largely unexplored. We demonstrated that after a sciatic nerve crush injury, the muscle spindle afferents supplied by the sciatic nerve exhibited altered morphology, characterized by a decrease in axonal width and an increase in inner rotational distance, compared to the uninjured leg.

102 Does Zn deficiency promote kidney damage?

Hasrat, Khanzada; Wenegieme, Tara-Yesomi; McMichael, Kelia; Rockwood; Jananie; Waite, Aston; Nshuti, Adeline; Elased, Dalia; Barrett, Hannah; Williams, Clintoria R.
Mentor: Williams, Clintoria R.

Background: Chronic kidney disease (CKD) impairs the kidneys' ability to filter blood. End stage renal disease (ERSD), which is characterized by irreversible kidney fibrosis, progresses from CKD. Significant events in kidney fibrosis include the transformation of activated renal cells into myofibroblasts and the subsequent deposition of Extracellular Matrix Proteins. Previous studies have shown CKD patients are zinc deficient which is a critical micronutrient that is responsible for supporting several physiological processes in the body. Based on these findings, we hypothesize that zinc deficiency promotes kidney fibrosis. Experimental Design: To investigate the role of zinc in renal damage, wild type, adult mice (C57BL/6J) were on either a Zn-adequate (ZnA) or a Zn-deficient (ZnD) diet for 10 weeks. To examine the effects of Zn repletion (ZnR), at week 8, a subset of ZnD mice was returned to the ZnA diet. At the end of the study, kidneys were harvested and processed for immunohistochemistry to assess kidney fibrosis. Study Objectives: The objectives of this study are to determine if zinc deficiency promotes 1) kidney fibrosis, and 2) renal cell activation. Significance: Collectively this study will explore if zinc deficiency promotes 1) renal fibrosis and 2) epithelial cell and fibroblast activation. These results will highlight the critical role zinc deficiency plays in promoting the damage associated with chronic kidney disease.

103 The Epithelial Na+ Channel is a Zn2+ Sensitive Renal Na+ Reabsorption Pathway that Mediates Zn2+ Deficiency-induced Hypertension

McMichael, Kelia Elizabeth; Wenegieme, Tara-Yesomi; Waite, Aston M.J.; Ume, Adaku C.; Williams, Clintoria R.

Mentor: Williams, Clintoria

We reported that Zinc deficiency induces hypertension by promoting renal sodium reabsorption. We hypothesize that ENaC mediates zinc deficiency-induced hypertension. To this end, wild-type mice were placed on a zinc-adequate or zinc-deficient diet. A subset of Zinc deficient mice was treated with an ENaC inhibitor. Invitro, western blot analysis performed showed that TPEN-induced ZnD stimulated both αENaC and βENaC protein expression. Immunohistochemical staining of kidneys from zinc-deficient mice revealed αENaC protein increased compared to zinc-adequate mice. Our findings reveal that ENaC is a Zinc-sensitive renal sodium reabsorption pathway and ENaC mediates ZnD-induced hypertension.

104 Repeated Occupational-Level Exposure to the Pesticide Malathion Leads to Neuronal Atrophy in the Dorsal Root Ganglion

Mcneil, Arian K.; Romer, Shannon; Sonner, Martha; Ladle, David
Mentor: Ladle, David

Environmental exposure to organophosphate (OP) pesticides, such as malathion, is a risk factor for neuropathy and neurodegeneration. Toxic levels of OPs irreversibly inhibit acetylcholinesterase (AchE) activity, leading to acute paralysis and even death as the neurotransmitter acetylcholine accumulates at cholinergic synapses. In addition, there is compelling evidence that repeated low-level "occupational-like" exposure to OPs is associated with somatosensory defects but the cellular mechanisms for this effect are unclear. We show sensory neuron cell size in the dorsal root ganglia is significantly reduced in rats exposed to occupational level malathion. However, co-administration of a reversible AchE inhibitor, galantamine, prevented this effect.

105 Repeated Exposure to the Organophosphate Insecticide Malathion Underlies Motor Performance Changes in Rats

Miller, Kaitlyn; Sonner, M.J., Procopio, H.M.; Stricker, J.L.; Warwick, H.I.; Phillips E.A.; McMeans, D.R.; McInturf, S.M.; Spencer, M.A.; Romer, S.H.
Mentor: Romer, Shannon

Although organophosphates are known neurotoxicants, they remain in use as flame retardants, engine oil additives, herbicides, and are heavily used as pesticides. Malathion is a frequently used organophosphate pesticide in the United States. Acute exposure to organophosphates can lead to muscle paralysis and possibly death through inhibition of cholinesterase activity. Low-level repeated exposures, that may occur in occupational or operational settings, are also linked to adverse neurobehavioral effects in humans and animals even though these exposures do not severely impact cholinesterase levels (<10 %). Repeated occupational exposure to malathion also correlates with cognitive deficits in humans. Despite known behavioral impacts, there are little data available as to how repeated occupational exposure to malathion impacts locomotion, motor neurons and their innervation of skeletal muscle at neuromuscular junctions. It is also unknown if repeated exposure to malathion presents a risk factor for locomotor performance decrements. We hypothesized that repeated occupational exposure to malathion results in locomotor deficits with anatomical alterations in the motor unit consistent with neurodegeneration in rodents. To test our hypothesis, male and female adult Sprague Dawley rats were exposed to 50 mg/kg of malathion via subcutaneous injections once daily for five days a week for four weeks total. Locomotor behavior was assessed within one week following the last injection and included open field motor activity, rotarod/accelerod and grip strength. In male rats, malathion exposed animals were less active in the open field, with activity times for control animals of 1488 ± 150 seconds (mean ± standard deviation) while animals exposed to malathion displayed mean activity times of 1253 ± 151 seconds. Male rats exposed to malathion also demonstrated locomotor deficits and fell off the accelerod approximately 54 seconds earlier than control animals, with no significant differences in forelimb or hindlimb grip strength. Female rats exposed to malathion also were significantly less active in the open field compared with control animals (1101 ± 218 seconds and 1357 ± 122 seconds, respectively). Unlike males, female rats exposed to malathion performed the same as control animals on the accelerod but had a significant decrease in forelimb grip strength (0.86 ± 0.13 kilograms for control and 0.72 ± 0.12 kilograms for malathion exposed females). We postulate that these neurological differences may be associated with anatomical changes observed at the neuromuscular junction in malathion exposed rats that are consistent with neurodegeneration. Altogether, our results suggest that the effects of repeated exposure to malathion can affect motor function differentially in male and female rats.

106 Motor Deficits in the C9orf72 and FVB/NJ Mouse Model of ALS

Salinas, Isabella; Ellington, Cierra; Garret, Teresa L.; Elbasiouny, Sherif M.
Mentor: Elbasiouny, Sherif M.

The C9orf72 hexanucleotide (GGGGCC) repeat expansion is one of the most common genetic mutations found in people who have Amyotrophic Lateral Sclerosis (ALS). Factors such as genetics (familial) and environment (sporadic) are known to play a development in the disease. The C9-500 mouse model has the background of the FVB/NJ mouse line. The C9-500 has motor dysfunction and variations in behavior. Behavioral assessments in both negative and positive mice resulted in increased neuroscore, reduced forelimb and hindlimb grip strength, and a low percent completion in rotarod. Leading to the question, is the C9-500 mutation responsible for inconsistencies or is it due to its FVB/NJ background strain? Further assessments performed on the FVB/NJ line resulted in similar motor characteristics seen in C9-500 model. Indicating that the FVB/NJ background influenced the expression of motor dysfunction and is not suitable to study motor behaviors. These results clearly show that characterizing the background strain is imperative for model development.

107 ETV1, Gene Regulation and Ets Binding Sites

Whorton, Amelia Joy; Ladle, David
Mentor: Ladle, David

ETV1 is a member of the ETS transcription factor family. It is essential for development and maturation of many tissues and processes such as proper development of the stretch reflex which is imperative for movement coordination and muscle integration (Arber et al., 2000; Ladle and Hippenmeyer, 2023; Tenney et al., 2019). Furthermore, it plays an important role in the establishment of fast conduction within the heart (Shekhar et al., 2016). However to our knowledge, little is known about the genes regulated by ETV1 in motor neurons. this implies that the underlying deficits leading to stretch reflex breakdown are still elusive. This project aims to computationally identify binding sites for Etv1 in target genes. We investigated if the number of binding sites correlates to fold change.

108 Exploring the Impact of Reduced Cardiomyocyte Complex/Hybrid N-Glycosylation on Heart Failure Progression

Young, Anthony Milard; Ednie, Andrew; Bennett, Eric
Mentor: Bennett, Eric

The heart requires a precise synchronization of its cardiomyocytes (CMs) to efficiently pump blood throughout the body. This action is brought about through the conduction of action potentials between CMs triggering an effective contraction of the cardiac tissue to eject the blood. This work sets out to elicit the functional role N-glycans play in this complex electromechanical system. N-glycosylation is a common post-translational modification that attaches branching polysaccharide structures to asparagine residues on the extracellular surface of transmembrane proteins. Here, we characterized a mouse model that develops heart failure (HF) following a reduction of CM complex/hybrid N-glycosylation using a tamoxifen-dependent, cre-lox knockout of GlcNAcT1 (iMgat1KO). Echocardiographic and cellular imaging techniques were employed to assess the condition of cardiac health in these mice. The gross cardiac function deteriorated at 28 days post induction (dpi) with a 35% reduction in ejection fraction following the induction of aberrant N-glycosylation. Interestingly, the physiologic function of isolated iMgat1KO CMs did not demonstrate typical pathophysiologic remodeling associated with HF through 110dpi. There was a lack of aberrant calcium handling or contractility in these CMs. This suggests that the HF is not a direct cause of dysfunction within individual CMs. However, we hypothesize that the modified state of N-glycosylation could be interfering with the vital cell-cell, electromechanical communication within the heart. Current studies include using echocardiographic strain to assess the synchronicity of cardiac contractility and immunofluorescent assays to examine the structural integrity of the intercalated discs responsible for electromechanically coupling neighboring CMs. These investigations will help determine how reduced levels of CM N-glycosylation contribute to heart failure onset and progression through altered intercellular communication.

Pharmacology and Toxicology

109 Potential role of Tti1 of TTT complex in regulating DNA replication checkpoint in fission yeast

Bhadra, Sankhadip; Xu, Yong-jie; Khan, Saman; Dev, Kamal; Yurtsever, Ilkner
Mentor: Xu, Yong-jie

DNA replication can be perturbed by various agents that slow or stall replication forks, causing replication stress. For example, hydroxyurea (HU) slows all on-going forks by depleting cellular dNTPs and methyl methanesulfonate (MMS) pauses a subset of the forks at the sites of DNA damage on the templates. If undetected, stressed forks collapse, causing mutational chromosomal DNA damage or cell death. In response to the stress, eukaryotic cell activates the replication checkpoint to deal with the stress by mobilizing several cellular pathways. The replication checkpoint is controlled by the protein kinases ATR and ATM that function as the sensors of the stressed or broken forks. ATR and ATM are members of the phosphatidylinositol-3-kinase-related kinases (PIKKs) and their stability are regulated by the TTT (Tel2-Tti1-Tti2) complex. According to the current model, the TTT complex works with Hsp90 as a co-chaperone via R2TP complex for co-translational maturation of all PIKKs and thus promotes their proper folding and stability.
We have previously reported a tel2-C307Y mutant in fission yeast. This mutation eliminates Rad3 (hATR/scMec1)-mediated signaling in the replication checkpoint pathway but moderately reduces Rad3-mediated signaling in the DNA damage checkpoint pathway, suggesting a potential role of the TTT in regulating the replication checkpoint. Here, we investigated this potential function of the TTT by taking a genetic approach to analyze the functions of Tti1, the largest component of the TTT complex. Based on our screening data of the newly identified mutants of tti1 in the DNA replication and the DNA damage checkpoint pathways, we hypothesize that Tti1 of the TTT complex regulates the replication checkpoint downstream of Rad3 and may possess an Rad3 independent alternative mechanism.

Physics

110 Ultra-High Temperature RF Material Characterization using Rectangular Waveguide

Zechar, Nathan Edward
Mentor: Medvedev, Ivan

High temperature material characterization of a material's constituent properties using a metal rectangular waveguide environment becomes problematic as the metal's oxidation rate and thermal expansion increases with temperature, damaging and deforming the waveguide. In addition to this, as temperature increases, the thermally radiated power at the surface of a sample material may become significant enough to affect the coax to waveguide launchers within the characterization system. This additional source of incident heat on the waveguide launchers are not present during TRL calibrations and must be absorbed and dissipated. A system consisting of a vacuum tight waveguide cooled on both ends and hermetically sealed windows capable of absorbing and dissipating thermal radiation is evaluated using simulations. Results are presented which show this system can accurately measure isotropic materials at elevated temperatures.

Psychology

111 Gender Stereotypes in Higher Education

Applegate, Kamara; Jackson, Sarah
Mentor: Jackson, Sarah

Gender prejudice has been shown to affect mental health negatively; however, more research is needed to compare the unique experiences of men and women in STEM and non-STEM majors regarding gender prejudice, gender stereotype endorsement, self-efficacy, and social support. This study evaluated the impact of gender stereotypes on self-efficacy in undergraduate students (N = 212). We expected experiences with gender stereotypes to correlate with self-efficacy negatively, and we expected this relationship to be stronger in women and STEM students. We expected social support to moderate the relationship between experiences with gender stereotypes and self-efficacy. We also expected that students in STEM would have more awareness of gender stereotypes than non-STEM majors, and this difference would be stronger for women than men. Lastly, we expected self-efficacy to correlate positively with academic performance (GPA). We found experiences with stereotypes were significantly negatively correlated with self-efficacy and this relationship was stronger in women than men. Surprisingly, this relationship was stronger in non-STEM than in STEM majors. Social support did not buffer the relationship between experiences with gender stereotypes and self-efficacy. However, both social support and experiences with stereotypes were significant predictors of self-efficacy. Awareness of stereotypes was not higher in STEM than non-STEM, but it was higher for women than men in both STEM and non-STEM. Lastly, self-efficacy was positively correlated with academic performance (GPA). These findings suggest that women in both STEM and non-STEM majors more often encounter threats to their self-efficacy through experiences with gender stereotypes and gender prejudice. Resilience could be a possible moderator between stereotype experiences and self-efficacy. Future research should include self-efficacy and stereotype endorsement, specifically regarding STEM and resilience measures.

Raj Soin College of Business

Marketing

113 Revolutionizing Business Process: An AI Integration With ERP

Adeola, Oluwadamilare Adegbite; Asamoah, Daniel
Mentor: Asamoah, Daniel

The evolution of Enterprise Resource Planning (ERP) systems through the integration of advanced features and technologies has significantly reshaped the global business landscape in recent decades. This evolution has been driven by ERP's ability to offer a comprehensive approach, creating transparency within organizations and fostering innovation. ERP systems, known for their modularity and adaptability to changing business practices, aim to optimize resource management and facilitate expansion and revenue generation. However, the integration of ERP into operations is not without its challenges. While it serves as a valuable information repository, enhancing data administration and decision-making, ERP implementation can be time-consuming, particularly for startups. The intricacies of ERP features and modules may pose comprehension challenges, compatibility issues, integration hurdles, and data exchange among modules can become obstacles. In response to the dynamic business environment's demands for operational efficiency, cost reduction, and adaptability, ERP providers have continually innovated and aligned with evolving trends. One of the most significant innovations has been the integration of Artificial Intelligence (AI) into ERP, ushering in a transformative era. AI-enhanced ERP systems empower decision-makers by providing insights, critical thinking capabilities, adaptive actions, and environmental awareness. This study explores the profound impact of AI integration within ERP across various domains. It highlights how AI optimizes processes, enhances resource allocation, and improves customer experiences. Specifically, AI's influence is showcased in customer service, sales automation, inventory management, manufacturing, quality assessment, advanced analytics, and financial management. This integration fosters operational excellence, enabling businesses to make data-driven decisions, gain predictive insights, and streamline their processes. Despite the challenges associated with AI integration, its role in ERP heralds operational excellence, allowing businesses to navigate complexity, drive innovation, and achieve growth. The transformative potential of this integration reshapes business processes and significantly enhances decision-making across various domains, positioning organizations for sustained success in the dynamic and competitive business landscape. As technology continues to evolve, the importance of AI-ERP integration remains pivotal for organizations seeking growth and adaptation in an ever-changing environment.

114 Digital Marketing Makes Consumer Closer: An Internet Giant Creating Challenges at Present: A Study on Consumer Perspective During COVID-19

Eti, Ismat; Bari, Murshedul
Mentor: Goodrich, Kendall

All businesses approved many tactics where digital marketing is the unsurpassed one that is so flexible, trackable, and accessible and having exclusively placed to reach business ambitions. During the COVID-19 pandemic, incredible challenges faced by many businesses. Consumer awareness and attitude are imperative because it provides a good perception to create content about product or services. So here, digital marketing is light of heaven that has opened up the way to touch consumers. This paper has intentions to illustrate a wide present literature and on what is happening in the business world related to the idea of digital marketing and descriptive analysis is used to examine the practice during COVID-19 pandemic towards business performance. This paper mainly focus on conceptual understanding of digital marketing and is concerned with consumers and also allows the customers to interact with the product by virtue of digital media. The paper is based on secondary data such as many articles, reports, various websites and information on the internet have been reviewed. In this study, We agreed that businesses can genuinely benefit from Digital Marketing such as search engine optimization (SEO), content marketing, social media marketing, e-mail marketing, online advertising. It has converted one of the powerful weapons that make new alignment for all business so firms should plan an aimed attitude formulating planned conclusions.

115 Connecting with Consumers Can Lead Successful Business In Retail Banking

Mahmud, Sifat; Goodrich, Kendall
Mentor: Goodrich, Kendall

Customer service is a key element of success in the retail banking industry, as it is essential for connecting with consumers and achieving long-term growth and profitability. The provision of quality customer service can result in increased customer satisfaction, loyalty, and market share. One key element is CRM, which is an essential strategy for managing and analyzing customer interactions and data throughout the customer lifecycle. In addition, retail banks have adopted digital marketing strategies to enhance their customer service and connect with consumers more effectively. Another important element is the implementation of one-stop solution points, which can provide customers with convenient and efficient services. Moreover, strong customer service training programs are vital for employees to provide quality customer service and ensure consistency in the delivery of service excellence Retail banks also need to provide user-friendly instructions to customers to enhance their understanding of banking products and services. Identifying happy and dissatisfied customers is also crucial for retail banks, as it allows them to address customer complaints and enhance their customer service. Furthermore, identifying customers most likely to give referrals is vital to increase positive word-of-mouth and generate new business. Therefore, this research will investigate the relationship between these customer service elements and their impact on customer satisfaction, growth, and profitability in the retail banking industry. The research questions will explore the most highly related customer service elements to customer service excellence, the relationship between customer service excellence and customer satisfaction, the relationship between customer satisfaction and positive financial institution results, and the direct relationship between some customer service elements and positive bank results.

https://www.wright.edu/event/celebration-of-undergraduate-graduate-research-scholarship-and-creative-activities