28th Annual
Graduate Student Research Symposium & Exhibit

Sponsored by
the Graduate Student Association
& Graduate School

April 23, 2025

University Student Commons,
Commonwealth Ballrooms

gsa Graduate Student Association at VCU

VCU Graduate School

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April 23, 2025

Dear Participants and Guests,

I am pleased to welcome you to the 28th Annual Graduate Student Research Symposium and Exhibit sponsored by the Graduate Student Association (GSA) at Virginia Commonwealth University. The Symposium is organized by graduate students and provides them an opportunity to display their scholarly work and cutting-edge research.

The Research Symposium and Exhibit also gives our faculty, staff, undergraduate students, and other members of our university community a chance to witness the outstanding work of our graduate students. The work presented today covers an array of topics reaching across many academic disciplines, representing the impressive scholarship of our graduate student body. I congratulate all of this year's presenters for their contribution to the success of this important program.

I would particularly like to thank Marie Michenkova, chairperson of the Symposium, and the officers of the GSA who have helped in planning this Symposium. This event is an excellent example of how an active GSA can benefit all graduate students.

Thank you for attending this year's Symposium. I hope that you enjoy the event.

Sincerely,

Manu Gupta, Ph.D.
Vice Provost and Dean
VCU Graduate School

Graduate Student Association

What is the GSA?
The Graduate Student Association (GSA) provides many valuable services to the graduate student body at Virginia Commonwealth University (VCU). The GSA organizes events throughout the academic year including Graduate Student Orientation, Meet & Greet events and social mixers, and the Graduate Research Symposium & Exhibit. The GSA also appropriates funds for graduate student organizations to enhance the quality of the graduate student experience at VCU. Finally, the GSA helps to place graduate students on campus committees, where they represent the voice and express the concerns of VCU's graduate student body.

Our Mission:
The purpose of the GSA is to serve as an advocate for the issues and needs of the graduate students at VCU. The GSA is committed to facilitating programs that enhance the academic skills, professional development, and social environment of all graduate students. There is no fee to join the GSA, every graduate student is a member and eligible to participate in and contribute to the GSA and GSA activities. However, the GSA-sponsored events are not limited to graduate students – all students and faculty are welcome.

Executive Committee:
The purpose of the GSA Executive Committee is to represent, advocate, facilitate communication and provide social activities for the VCU graduate community.

2024-2025 Executive Committee

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GSA Council:
The purpose of the GSA Council members is to represent VCU graduate schools, programs and departments by relaying student concerns to the GSA and the Executive Committee. The GSA is looking for representatives from each school to form the Graduate Student Council. Applications may be found at: https://graduate.vcu.edu/life/graduate-student-association/

More Information:
For more information about the GSA, please visit: https://graduate.vcu.edu/life/graduate-student-association/

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gsa Graduate Student Association at VCU

2025 Symposium Judges

A heartfelt thank you to all the faculty and staff who supported the graduate students presenting today, as well as those faculty who were involved in the symposium but not named below. We could not host such an innovative event without your help!

College of Engineering
Tom Roper, Ph.D.
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College of Humanities & Sciences
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Stacey Wahl, Ph.D.
Alexandra Lempke, Ph.D.
Jessie Oldham, Ph.D.
Lisa Shock, Ph.D.
Javier Gonzalez-Maeso, Ph.D.
Lane Fickert, Ph.D.
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Caitlin Matzke, D.N.P.
Chris Schreiner, Ed.D.

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Karen Chartier, Ph.D.

School of Business
Tanya Wineland, M.S.
Brittany Elmore, Ed.D

School of Public Health
Dina Garcia

Massey Comprehensive Cancer Center
Caroline Blair, M.P.H.
Heidi Sankala, Ph.D.

Division of Student Affairs
Lisa Cooper, Ed.D.
Taylor Jackson, M.Ed.

VCU Career Services
Virginia Damron, M.Ed.

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College of Engineering

Fibrosis Pathways and Mitigation for Arthrofibrosis Using microRNA

Kait E. Hosmer[1], Stephen Kates[2], Christine Van Duyn[1], David J. Cohen[1], Zvi Schwartz[1], Barbara D. Boyan[1,2]

Background: Arthrofibrosis, a complication of total knee arthroplasty and ACL injuries, is characterized by scar tissue formation, leading to restricted joint movement and diminished quality of life. Currently, no effective preventative treatment exists. We investigated microRNA-based therapies to mitigate post-surgical arthrofibrosis and explored the underlying fibrotic pathways.

Methods: *In vitro* studies were conducted using rat kidney fibroblasts (NRK-49F) to examine canonical (TGF-β1/SMAD3) and non-canonical (CTGF) fibrotic pathways. The circadian clock regulator Rev-Erbα and microRNAs miR-21 (profibrotic) and miR-29s (antifibrotic) were assessed. Cells were treated with varying concentrations of TGF-β1, CTGF, Rev-Erbα agonist/antagonist, and SMAD3 inhibitor. MicroRNA regulation was examined using miR-21 and miR-29 mimics and inhibitors. Fibrosis markers α-smooth muscle actin, collagen I/III, fibronectin, laminin, and vimentin were analyzed via dot blot.

Results: We confirmed fibrosis induction with 10 ng/mL TGF-β1 after 48 hours. CTGF treatment yielded inconsistent results, suggesting downstream effects requiring further study. The SMAD3 inhibitor effectively reduced all fibrosis markers, confirming its role in fibrosis. The Rev-Erbα antagonist reduced collagen III and fibronectin, while the agonist showed no significant effect. The miR-29 mimic and miR-21 inhibitor reduced fibrosis, suggesting their therapeutic potential, while the miR-29 inhibitor and miR-21 mimic had no significant effect.

Conclusions: We established an in vitro fibrosis model for investigating joint arthrofibrosis, particularly in synoviocytes. The inconsistent CTGF results show need for further investigation. The study suggests that SMAD3 mediates TGF-β1's effects and that Rev-Erbα modulation influences fibrosis. MicroRNA-21 inhibition and microRNA-29 mimicry demonstrate promise as therapeutic strategies for arthrofibrosis.

Predicting Complex Di-Alkylation Kinetics Using Machine Learning

Colin Bailey

Background: Predicting reaction kinetics for complex chemical systems often presents significant challenges due to intricate reaction pathways, multiple product formations, and competing side reactions. Additionally, the transient nature of reaction intermediates and limited experimental data complicate efforts to capture system dynamics accurately. These complexities necessitate

advanced modeling approaches and precise experimental techniques to reliably describe and predict chemical behavior.

Methods: This work investigates the kinetics of di-alkylation of 4-Hydroxybenzoic Acid (4-HBA) using multiple machine learning algorithms, including Random Forest Regression, Gradient Boosting, Lasso, Ridge, and XGBoost. By leveraging reaction conditions, such as temperature, sulfuric acid equivalents, and initial concentrations of reactants, the developed models accurately predict concentrations for various reaction species.

Results: The predictions demonstrate good correlations with experimental results, achieving high accuracy with R^2 values for some compounds. Hyperparameter optimization was systematically performed using Bayesian optimization methods and validated through Leave-One-Group-Out (LOGO) cross-validation to mitigate the risk of overfitting.

Conclusions: Future work includes changing the scoring method from R^2 to RMSE, MAE, or a custom scorer to assess if enhanced real-world model prediction performance can be achieved.

Anomalous Temperature Effect on the Deposition Morphology in Reactive Inkjet Printing

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Background: Reactive inkjet (RIJ) printing is a promising technique for printed electronics, offering an alternative to traditional inkjet printing, which relies on colloidal inks containing nanosized metal particles. Instead, RIJ printing utilizes metal organic decomposition (MOD) inks, which consist of metal-organic compounds that transform into pure metal electrodes through a post treatment reduction process. While RIJ printing of MOD inks has been successfully demonstrated, the underlying mechanisms governing droplet deposition and film formation remain insufficiently explored. Understanding these processes is crucial for optimizing printed electronic devices.

Methods: This study investigates the effect of substrate and nozzle temperature on the deposition morphology of copper MOD ink during RIJ printing. Experiments were conducted at different temperatures to observe variations in droplet behavior and final film formation. Additionally, a comparative analysis was performed between copper and silver MOD inks to understand the influence of different solvent systems on deposition patterns.

Results: The study found that elevated substrate and nozzle temperatures led to significant changes in the deposition morphology of copper ink compared to room temperature conditions. These differences were attributed to the formation of a localized seeding layer, which facilitated the attraction and accumulation of copper ions during the deposition process. Furthermore, copper and silver MOD inks exhibited distinct deposition behaviors due to variations in their solvent compositions.

Conclusions: A deeper understanding of the deposition mechanisms in RIJ printing provides valuable insights for improving the fabrication of printed electronic devices. The findings highlight the role of temperature and solvent systems in determining film morphology, which can aid in optimizing RIJ printing processes for enhanced conductivity, precision, and performance in functional printed circuits.

Altered Theta-Delta Relationship Reveals Impaired Sleep Architecture Parkinson's Disease (PD)

Tina Naik MEng, Omonigho Bubu MD, PhD, MPH; Dean Krusienski PhD; Brian Berman MD

Background: Conventional single-band spectral analysis of sleep electroencephalography (EEG) data fails to capture the dynamic interplay of homeostatic sleep rhythms. In PD increased theta (θ) overlaying delta (δ) bandpower during sleep has been observed but not yet captured. Bandpower ratios and time-course relationships *reflect the temporal dynamics of oscillatory homeostasis* and *may serve as physiologically relevant EEG markers of impaired sleep*.

Hypothesis: Altered bandpower relationships reflecting disrupted homeostasis, primarily the θ/δ ratio and θ-δ relationship, will significantly differ between PD and controls.

Methods: Sleep EEG data was collected from 54 participants (PD=36, controls=18). Spectral power (delta: δ, theta: θ, alpha:α, sigma: σ, beta: β) were computed across sleep stages (N2, N3, N2+N3, REM). Bandpower ratios and time-course relationships assessed altered homeostasis. Spearman's correlations assessed θ-δ temporal dynamics. Stage-based time-course plots visualized physiological oscillatory dynamics.

Results: PD exhibited increased θ/δ compared to controls, with exploratory analyses showing increased θ/δ during N2 in PD-MCI (mild cognitive impairment) and N3 in both PD-MCI and PD-NC (normal cognition). Controls exhibited a positive θ-δ relationship and cyclic non-NREM dissipation, indicating preserved oscillatory homeostasis. The θ-δ relationship exhibited a more negative (inverse) in PD during N2 and N3. Altered θ-δ dynamics were observed in N2 (both subtypes), N3 (PD-NC), and REM (PD-NC).

Conclusion: Theta-delta dynamics may differentiate PD subtypes, with N3 dominance in PD-NC and N2 dominance in PD-MCI. Novel stage-based time-course plots surpass conventional hypnograms, in visualizing underlying altered sleep spectral architecture. Dual-band interactions provide a homeostatic marker of impaired sleep that strengthens diagnostic specificity.

Breaking the Boundaries of Bayesian Optimization Utilizing Continuous Chemistry Digital Twins

Bao Chau, Yuma Miyai, Thomas Roper

Background: Chemical reaction optimization is a rapidly evolving field of research involving advanced statistical modeling. Chemical reaction design spaces tend to be multidimensional with multiple outputs creating a complex optimization problem that requires experienced chemists' intuition and multiple iterative procedures. To counteract the complexity, optimization methods have been developed to leverage modeling and algorithmic optimization. Recent work has shown that Bayesian optimization (BO) is a powerful upcoming tool for optimization. Our hypothesis is that Bayesian Optimization algorithms can be supplemented with autonomous data analysis to lower the barrier to entry for optimization whilst improving overall efficiency.

Method: The first digital twin is a benchmark implementation in Summit for a nucleophilic aromatic substitution reaction of difluoronitrobenzene with pyrrolidine. The second is an in-house kinetic model of a multistep continuous manufacturing synthesis platform of ciprofloxacin intermediate.

Results: BtB-BO displayed 100% success rate with all stress tests and performs best when given free rein over the entire process. BtB-BO was able to exceed the objective function goal for both in-house and S_NAr case studies. BtB-BO expands boundaries successfully identifying high performance regions in under 40 total experiments and minimal prior knowledge.

Conclusion: Our BtB-BO approach successfully expands the boundaries of the design space for specific parameters to obtain a global maximum for various chemical processes. BtB-BO outperformed the current state-of-the-art BO method for chemistry optimization in all hindered design spaces whilst maintaining low iteration count.

Sequential Nanosecond and Femtosecond Laser Treatments on Titanium Implant Had Synergistic Effects on Osteogenic Differentiation

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Background

Enhancing implant surfaces to improve osseointegration is crucial for reducing implant failure and patient recovery time. Ti6Al4V is widely used for spinal implants due to its favorable mechanical and biological properties. Laser modification of Ti6Al4V surfaces has been shown to promote osseointegration by mimicking osteoclast resorption pit morphology, encouraging bone marrow stromal cells (MSCs) to differentiate into an osteoblastic phenotype.

Methods

This study examined MSC responses to Ti6Al4V implants treated with nanosecond (Ns) and femtosecond (Fs) lasers to produce micro/nano textures. Surfaces were characterized for wettability, surface chemistry, roughness and micro/nano-topography. Human MSCs were cultured on Ti6Al4V implants treated with nanosecond and femtosecond lasers for 7 days in growth media and analyzed via ELISA for osteogenic markers and local factors.

Results

Contact angle measurements for all machined surfaces except Femto were hydrophobic. NT and Femto additively manufactured surfaces were hydrophilic while Ns and Ns+Fs were hydrophobic. Roughness data revealed increased Sa and Sz values for Ns and Ns+Fs discs for both machined and additively manufactured. SEM imaging showed distinct topographical differences, with high-magnification images revealing nano-scale bumps on Femto surfaces and pebbled textures on Ns and Ns+Fs surfaces. Cell culture results indicated lower DNA content on all laser-treated discs compared to additively manufactured Fs discs. Osteocalcin (OCN) expression increased on Ns and Ns+Fs surfaces, suggesting enhanced osteoblastic differentiation. Additionally, VEGF levels were elevated on additively manufactured Ns and Ns+Fs surfaces, while OPG increased on Nano-Femto surfaces.

Conclusion

These findings suggest that Ns and Ns+Fs laser treatments promote MSC differentiation toward an osteoblastic phenotype, highlighting the potential of laser-modified Ti6Al4V implants for improved osseointegration.

Ventilation-Induced Lung Injury in Alzheimer's Disease: Effects of NLRP3 Deletion in Mice

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Background: Acute Respiratory Distress Syndrome (ARDS) arises from direct (e.g., ventilator-induced lung injury (VILI)) or indirect (e.g., sepsis) health conditions that trigger alveolar damage and recruit immune cells, worsening the condition. Alzheimer's Disease (AD) leads to progressive neurodegeneration due to amyloid plaque accumulation, activating microglia and inducing neuroinflammation. Both conditions are further exacerbated by the NLRP3 inflammasome that releases pro-inflammatory cytokines like IL-1β. The intersection of ARDS and AD poses significant risks, as ICU stays associated with ARDS have been linked to increased mortality and long-term cognitive decline, and nearly 50% of critically ill AD patients experience long-term neurocognitive and functional impairments post-ICU, emphasizing the need to address systemic inflammation during critical care. This study investigates the role of NLRP3 in VILI.

Methods: Three groups were tested: 3xTg-AD mice, NLRP3 knockout (KO) 3xTg-AD mice, and wild-type mice. All were ventilated with high pressure (35cmH_2O) for 2 hours. Lung tissue and mechanics, cell counts, and IL-1β levels were analyzed.

Results: 3xTG-AD mice showed signs of lung stiffness by increased elastance, decreased compliance, and higher hysteresis. NLRP3 KO and wildtype groups stabilized themselves relative to their initial values. IL-1β was significantly elevated in the ventilated 3xtg-AD mice and reduced in KO mice, which confirms that ventilation triggers inflammation through NLRP3.

Conclusions: NLRP3 KO preserved lung mechanics and reduced inflammation, suggesting that it plays a central role in VILI. Targeting NLRP3 may improve outcomes for ventilated AD patients.

Effect of Synthetic Surfactant Dry Powder Aerosol on Acute Respiratory Distress Syndrome-Related Hypoxemia

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Introduction: Acute respiratory distress syndrome is a severe form of lung injury characterized by pulmonary edema, rupture of the alveolar-capillary barrier, and breakdown of surfactant production. In mechanically ventilated ARDS patients, prevalence of hypoxemia is up to 54%, with a mortality rate of over 27% overall [1]. Without functioning surfactant production, the lung is prone to alveolar collapse, increased edema, and cytokine storm [2–4]. This study aims to examine the effects of synthetic surfactant dry powder aerosol on lipopolysaccharide-induced ARDS and hypoxemia.

Methods: Sprague Dawley rats weighing 350-450 g (males) or 300-350 g (females) were anesthetized, dosed according to experimental group with 2.5 mg/kg LPS in 0.5 mL/kg of 0.9% saline solution or 0.9% saline alone, recovered for 24 hours, then were dosed with surfactant dry powder aerosol one, two, and three days post-injury. After the third dose, animals were ventilated and samples including bronchoalveolar lavage fluid, fixed and frozen lung tissue, blood gas, and lung mechanics were collected.

Results: IVIS imaging shows that the surfactant has widespread deposition in the LPS-injured lung. This indicates that the dry powder aerosol is an effective way to deliver surfactant to the airway and distal regions of the lung. Additionally, surfactant decreases hypoxemia.

Conclusions: Results show that the surfactant is well distributed in the injured lung, indicating that the delivery of the drug is effective. Further studies include efficacy experiments including BALF protein and cytology analysis, blood gas analysis, and lung histology.

Exploring the Therapeutic Potential of microRNA-145 in Bone Regeneration Applications

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Background: MicroRNAs (miRNAs) are small non-coding RNA sequences that have emerged as potent regulators of gene expression, and implicated as modulators of a variety of cell processes including proliferation, differentiation and disease. The aim of this study was to explore the potential of one such miRNA, miRNA-145, in modulating stromal cell fate for bone regeneration delivered using a clinically translatable technology.

Methods: Lipid nanoparticles (LNPs) physical properties were measured, including size, polydispersity index (PDI), zeta potential, and cell uptake. Human bone marrow stromal cells (bMSCs) were cultured for 14 days. On day 11, cells were treated with miR-145 mimic or inhibitor. Cell monolayer and media were harvested and assessed for production of osteogenic differentiation markers.

Results: LNPs were found to be ~80nm in diameter with a PDI <0.2 and neutral surface charge. Fluorescent microscopy showed successful cell uptake of miRNA strands. Treatment with miRNA-145 mimic decreased production of osteogenic differentiation markers OPN and OPG. Treatment with miRNA-145 inhibitor increased production of osteogenic markers OCN and OPN.

Conclusions: The data demonstrate that miRNA-145 plays a role in bMSC fate determination and LNPs are capable of encapsulating miRNA for delivery. Further studies will explore using the LNPs to modulate bMSCs differentiation through targeted delivery to further localize and improve their biological effect.

Characterization of Globus Pallidus Internus Dynamics in Freezing of Gait

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Background: Parkinson's disease (PD) is a progressive neurodegenerative disorder affecting ~1 in 1000 individuals over age 45. Freezing of Gait (FOG), a debilitating symptom in late-stage PD, affects up to 63% of patients and contributes to falls and reduced quality of life. While deep brain stimulation (DBS) of the subthalamic nucleus (STN) helps some symptoms, FOG remains difficult to treat. Given the complexity of basal ganglia circuitry, the role of related basal ganglia nuclei, such as the Globus Pallidus internus (GPi), in FOG deserves further investigation.

Methods: Five PD patients with FOG, implanted with Medtronic Percept DBS systems (sampling at 250 Hz), completed obstacle courses designed to elicit FOG (e.g., path obstruction, turns) **(Figure 1)**. Local field potentials (LFPs) from GPi were recorded during standing, walking, and freezing episodes. Ankle accelerometers captured gait data. LFPs were analyzed spectral parameterization from 1-125 Hz. Beta-Gamma Phase-Amplitude Coupling (PAC) was evaluated using beta (12–35 Hz) phase and gamma (40–95 Hz) amplitude bands.

Results: Spectral analysis showed increased exponent and offset values during standing, suggesting enhanced local inhibition in GPi. GPi PAC was highest during standing, lowest during walking, and intermediate during freezing; suggesting PAC is a normal pallidal response. This contrasts with the STN, where PAC is pathologically elevated during freezing.

Conclusions: These results support a spatial dissociation in PAC dynamics between GPi and STN during FOG. GPi PAC during freezing may reflect compensatory processing rather than pathology. Future work should explore GPi's role in modulating FOG-related motor control.

School of Medicine

Mechanistic Insight into Neuropilin-2 Expression During Prostate Cancer Progression

Negin Ziamiavaghi, Sanika Bodas, Kaustubh Datta

Background: Neuropilin-2 (NRP2) regulates prostate cancer progression, therapy resistance, and metastasis. However, the molecular mechanisms driving its increased expression remain unclear. We investigate how epigenetic modifications and transcription factor interactions contribute to NRP2 upregulation.

Method: DNA methylation analysis of prostate cancer cell lines and patient tissues was performed using EPIC sequencing and pyrosequencing. Gene expression levels were assessed via RT-qPCR and RNA sequencing. Chromatin immunoprecipitation (ChIP) identified transcription factors binding to the NRP2 promoter. Functional studies included transcription factor depletion and pharmacological demethylation. Circulating tumor DNA (ctDNA) from patients was analyzed to explore NRP2 promoter methylation as a biomarker.

Results: NRP2 expression is regulated by CpG island demethylation at its promoter. DNA methylation analysis revealed progressive loss of methylation at the NRP2 promoter in aggressive prostate cancer, enabling transcriptional activation. We identify SMAD3 as a key transcription factor binding to the demethylated promoter in both prostate adenocarcinoma and neuroendocrine-like prostate cancer. Additionally, SOX2 co-regulates NRP2 expression only in neuroendocrine-like prostate cancer.

Clinically, high NRP2 expression correlates with increased metastasis and poor survival. NRP2 promoter methylation in circulating tumor DNA may serve as a non-invasive biomarker for identifying aggressive prostate cancer and predicting treatment response.

Conclusion: These findings provide insights into NRP2 regulation and highlight its potential as a biomarker and therapeutic target for aggressive prostate cancer.

Hey Chat– What Should I do? Analysis of LLM Responses to Angiographic Emergencies

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Background: Large language models (LLMs) such as ChatGPT (Open AI, San Francisco, CA) is a type of artificial intelligence programing. ChatGPT has shown promising applications in medicine. We set out to examine ChatGPT's utility in identifying and suggesting management for hypothetical angiographic emergency scenarios.

Methods: A Delphi technique was utilized to create a set of 15 fictional angiographic emergencies (FAE) encountered by vascular surgeons.
A ChatGPT 4.0 prompt was used to describe the problem and the best next step. A five attending vascular surgeon panel evaluated each response in three domains (scale ranging from -3 to +3): quality of content, relation to consensus of the scientific community and likelihood of causing significant harm.

Results: The average score of all scenarios was 1.08 ± 1.4. The panel found that 18.7% of ChatGPT responses opposed with the scientific consensus, 12.0% had a high risk of harm, and 25.3% included incorrect or inappropriate content. 53.3% of ChatGPT responses had no problem with content (Figure 1). Two scenarios were scored perfectly by all evaluators.

Conclusions: While Chat GPT 4.0 may have some utility in identifying and managing angiographic emergencies, its clinical use is limited by knowledge deficits. The majority of ChatGPT provided content was aligned with the consensus of the scientific and clinical community, but nearly 25% included some incorrect or inappropriate content. Future studies may assess ChatGPT's understanding of angiographic emergencies through evaluating its ability to provide management recommendations for angiographic images.

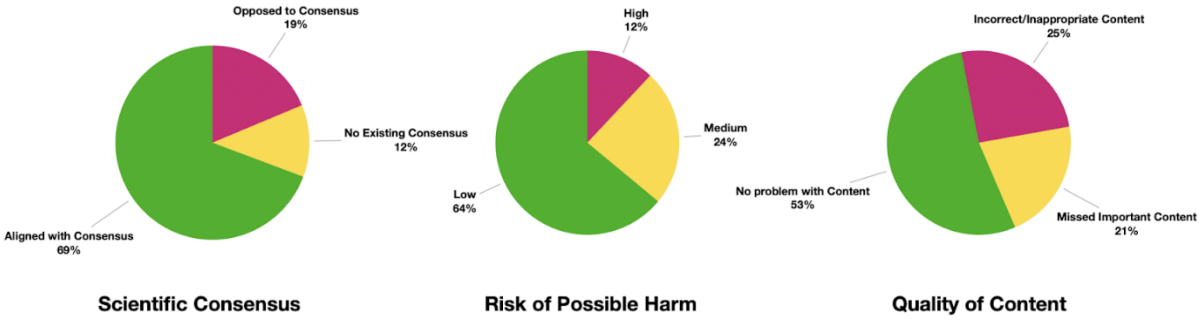

Figure 1. Summary of vascular surgery attending evaluations of 15 FAE.

Acceptability and Useability of a Didactic Research Curriculum for Medical Students

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Background: Medical students are encouraged, and often expected, to conduct research throughout their education but formal instruction is not universally provided.. A research didactics course could provide this necessary support and direction. This study aims to assess the acceptability and useability of a didactic research curriculum designed for medical students participating in a summer research fellowship within a clinical research laboratory affiliated with an urban, public medical school.

Methods: 7 Medical students completed a 6-week summer research introductory course which included a curriculum covering research methods, ethics, and critical review of published papers. Upon course completion, 4 students underwent semi-structured interviews about their experiences in the course. Using an inductive approach, interview transcripts were coded by four independent reviewers and major themes were identified.

Results: Five themes were identified: 1) Students acquired new research skills during the course 2) Students took ownership and experienced independence in their research 3) Students desired personalized lesson plans 4) Students desired a balance between accessibility (e.g., virtual resources) and structure (e.g., deadlines) 5) Students believed the knowledge and skills gained from the course will impact them in their future careers as physicians.

Conclusion: Results indicate students found the summer curriculum to be both acceptable and useable. The acquisition of new skills (Theme 1) and the perceived value to future careers (Theme 5) emphasize the acceptability of the course. The ability for student independence Theme 2) and the perceived value to future careers (Theme 5) highlight the course's usability.

Acute Caffeine Overdose: A Toxicology Simulation Case for Fourth-Year Medical Students

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Affiliations

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Background: Caffeine is a readily available, widely used stimulant. Its overuse has led to increased cases of toxicity. Despite its popularity, preclinical pharmacology curricula do not often cover it, and few medical schools offer opportunities to explore toxicology, resulting in a gap in medical knowledge. Simulated cases allow students to experience caring for patients less commonly seen in clinical settings.

Methods: Fourth-year medical students took a pretest and then listened to a pre-recorded lecture on adenosine and methylxanthines, supplemented with a 1-hour flipped-classroom-styled review on key concepts. Students then participated in a simulation featuring a 9-month-old female who overdosed on caffeine in a pediatric exploratory manner. The simulation room was prepared with a pediatric mannequin, pediatric code card, intravenous/arterial/central lines, pharmaceuticals, and personal protective equipment. Critical actions included performing endotracheal intubation and cardioversion, administering benzodiazepines and multi-dose activated charcoal, and calling for emergent hemodialysis. Outcome measurements included posttest performance and completion of critical actions.

Results: Thirty-eight students participated; mean pretest and posttest scores were 51% and 91%, respectively ($p < 0.0001$). All groups completed the items on the critical actions checklist in 15 minutes.

Conclusions: Caffeine users might be unaware of the doses of caffeine for toxicity, and physicians may be unprepared to care for these patients due to lack of experience, resulting in detrimental outcomes. This simulation allows learners to treat patients with caffeine toxicity in a controlled setting. It solidifies their knowledge of performing critical actions and allows transferable skills to other specialties.

Digital Circulation: A Content Analysis of Peripheral Artery Disease Information on TikTok

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Background: TikTok, a growing social media platform, has over 150 million users in the United States. Over 50% of Americans report regular use of TikTok to get the latest information. We assess the quality of peripheral arterial disease (PAD) content on TikTok.

Methods: Four key phrases were searched on TikTok ("Vascular PAD", "Intermittent Claudication", "Peripheral Artery Disease", and "Acute Limb Ischemia"). The first 50 videos under each phrase were given a DISCERN score and analyzed for the type of creator, total likes, comments, shares, views, and run time. Videos were grouped into categories 1-5 based on DISCERN score. 1 being poor and 5 being excellent. Fisher's exact[†], student's t-test[*], and ANOVA was used for data analysis.

Results: 200 videos were included. 81 (8.1%) were created by physicians. 157 (78.5%) of videos were rated poor or worse. 0 videos qualified as excellent based on DISCERN score. Physicians were likely to have videos with higher DISCERN scores than non-physician creators (<0.001). Physicians had higher mean scores for most DISCERN questions than non-physicians. Videos with higher DISCERN scores had a lower number of views (0.037). Videos with lower DISCERN scores were likely to have shorter run times (<0.001).

Conclusions: Physician-created PAD TikTok videos generally had higher DISCERN scores, reflecting better quality and reliability. In contrast, videos with lower DISCERN scores had a higher number of views, which could result in the spread of misinformation about PAD, making TikTok an unreliable platform for users seeking accurate information about PAD.

Investigating the role of AtcS histidine kinase in *Treponema denticola* virulence

Hinson AN, Abdallah D, Moylan AD, Patel DT, Zhou B, Marconi RT, Miller DP

Background: Periodontitis is a chronic inflammatory disease characterized by the progressive destruction of tooth-supporting tissues. *Treponema denticola*, a Gram-negative anaerobic

spirochete, transitions from low abundance in healthy subgingival crevices to high abundance during disease progression. *T. denticola* contributes to tissue degradation and dysregulation through direct cytotoxic effects and immune evasion. Its periplasmic flagella enable motility in viscous environments, supporting its survival in the challenging conditions of periodontal pockets. Ability of *T. denticola* to adapt to dynamic environmental, immunological, and physicochemical changes is mediated by two-component systems (TCS). TCS consist of a histidine kinase and a response regulator that coordinates bacterial responses. The AtcS/AtcR TCS in *T. denticola* has potential as a global regulatory system, yet its specific mechanisms remain unclear.

Methods & Results: We utilized genetic manipulation to characterize the role of AtcS histidine kinase in *T. denticola*. RNA sequencing revealed significant downregulation of genes linked to motility, chemotaxis, and ABC transporters in the *atcS* knockout strain (Δ*atcS*) compared to the wild type. Functional assays confirmed impaired proteolytic dentilisin activity, motility, and chemotactic responses in Δ*atcS*. Mass spectrophotometry confirmed complete disruption of glycine consumption in Δ*atcS*. Furthermore, a murine periodontitis model showed that Δ*atcS* failed to induce alveolar bone loss, underscoring the TCS's role in virulence.

Conclusions: These findings highlight the role AtcS has in *T. denticola* regulation, contributing to proteolytic activity, motility, chemotaxis, and glycine transport. This work advances our understanding of sensory transduction systems in *T. denticola* and establishes AtcS/AtcR as a critical TCS that contributes to pathogenicity.

Sphingosine Kinase 2 in Sexual Dimorphism of MASH-driven HCC Tumor Microenvironment

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Background: Hepatocellular carcinoma(HCC) is the third leading cause of cancer mortality worldwide, with a higher incidence risk in males. Owing to the current obesity endemic, metabolic dysfunction-associated steatohepatitis(MASH) is a major contributing factor to HCC etiology. Importantly, bioactive sphingolipid metabolites, particularly sphingosine-1-phosphate(S1P), have been implicated in MASH-HCC pathophysiology. However, while S1P-generating enzyme sphingosine kinase 1(SphK1) has been significantly studied in HCC, much less is known about the other isoform SphK2.

Aims: To examine the role of SphK2 in MASH-HCC sexual dimorphism.

Methods: We utilized our 54-week diet(HFD/SW)-induced preclinical MASH-HCC model, which recapitulates the gradual progression of human MASH-HCC, to examine the effects of global SphK2 deletion in male and female tumor burden. To further investigate SphK2 in the

MASH-HCC tumor microenvironment, we developed macrophage-specific SphK2Δmac mice using our diet-induced model.

Results: SphK2$^{-/-}$ males were HCC-protected, whereas in females, tumors were only found in SphK2$^{-/-}$ livers, indicating a crucial role of SphK2 in MASH-HCC sexual dimorphism. Interestingly, higher pro-inflammatory cytokine levels and reduced M2-polarized (pro-tumorigenic) liver macrophage markers were associated with reduced HCC in SphK2$^{-/-}$ males, hinting an SphK2-mediated HCC microenvironment-modulation. *In vitro* studies with isolated SphK2-deleted macrophages further showed reduced M2 macrophage markers upon IL-4 activation, suggesting SphK2-mediated liver macrophage polarization, which significantly influences liver tumorigenesis.

Conclusion: In addition to SphK2 being a sexual dimorphism determinant in MASH-HCC, our findings emphasize the role of SphK2 in liver macrophage repolarization for immune-modulation. Taken together, our study sheds light on the important clinical implications of SphK2 in sex-based HCC immunotherapy.

TRIM28-mediated transposable element stability in the prefrontal cortex is implicated in social behavior changes

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Background: Engaging in social behavior is essential for group-based organisms, but chronic stress experience can lead to changes in social functioning, constituting a serious quality of life issue. Transposable elements (TEs) are mobile DNA segments that are increasingly appreciated as highly dynamic in response to experience and are implicated in *cis* regulation of genes. TE transcription is controlled by KZFP transcription factors with the repressive cofactor, TRIM28. Here, we employed synthetic TRIM28 constructs to differentially control TE transcription and observed behavioral and transcriptional consequences in unstressed and stressed mice.

Methods: Our TRIM28 constructs are delivered via herpes simplex virus to mouse prefrontal cortex. TRIM28^{WT} mimics the endogenous protein and recruits repressive chromatin machinery; TRIM28^{VPR} utilizes a VP64-p65-Rta (VPR) domain in place of the wild-type repressive domains and recruits chromatin activating proteins; and TRIM28^{NFD} contains a KZFP-binding domain but no functional domain. Following viral delivery, we tested social behavior in stress-naïve mice or in mice who underwent chronic stress prior to viral manipulation, then performed RNA sequencing.

Results: In stress-naïve mice, disrupting TRIM28's function with TRIM28^{VPR} or TRIM28^{NFD} caused nuanced deficits in social cognition, while overexpressing TRIM28^{WT} had no behavioral effect. These behavioral changes were mirrored by activation of TEs and dysregulation of immune-related genes. In stressed mice, while introducing TRIM28^{WT} did not reverse social dysfunction, future experiments will test if introducing TRIM28^{WT} before stress prevents these changes.

Conclusions: TRIM28-mediated repression of TEs is necessary for social behavior in stress-naïve mice, but its role in stress-induced social deficits requires further study.

Regulatory T (TREG) Cell Contributes to Tumor Cell Dissemination Via Extracellular Matrix (ECM) Remodeling.

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Background: The extracellular matrix (ECM) is a highly organized network consisting of structural proteins, growth factors, cytokines and other secreted molecules. The ECM is dynamic and is a critical player in the regulation of local invasion and metastasis. The ECM network is an important immunosuppressive component of the tumor microenvironment (TME). However, the reciprocal effects of the immune system on the tumor-associated ECM are elusive and largely unexplored. Regulatory T (Treg) cells function to enforce peripheral tolerance and are potent suppressors of tumor immunity. In this work, we sought to assess whether Treg cell-mediated immune suppression is associated with changes in the ECM, and functional impacts on metastatic dissemination.

Methods: Murine breast cancer models susceptible to toxin-mediated ablation of Treg cells were utilized. Combination of histopathological analysis, tumor decellularization, bioengineering 3D-chip modeling, *in vivo* manipulations and bioinformatic analysis, demonstrate loss of Treg cells results in remodeling of the ECM.

Results: Treg ablation leads to reduced amounts of collagen and fiber disorganization. Tumor cells seeding on tumor-derived decellularized ECM matrices results in reduced epithelial-mesenchymal transition (EMT), and profound impairment of collective migration. *In vivo*, Treg cell ablation resulted in significant reduction of circulating tumor cells (CTC) and impairment of lung metastatic disease. Additionally, we show that Treg cell ablation-driven changes in the matrisome correlate with long-term improved survival in a cohort of breast cancer patient samples.

Conclusions: We identify a novel metastasis-promoting effect of Treg cells in the breast cancer microenvironment through regulation of ECM dynamics.

A potential beneficial role of astrocyte secreted protein YKL40 in cuprizone induced de/remyelination model

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Background: Multiple sclerosis (MS) is a neurodegenerative disease affecting approximately 2.9 million people worldwide, characterized by myelin loss and cognitive decline. Among others, neuroinflammation, reactive-astrocytes and -microglia are hallmarks of MS and may contribute to the de/remyelination. Interestingly, cerebrospinal fluid levels of YKL40 are elevated in individuals with multiple sclerosis, yet its role during de/remyelination is unclear.

Methods: Previously, our lab identified YKL40 as an astrocyte-secreted factor whose expression is increased during developing brain and in neuroinflammation. Moreover, recently, our lab discovered that astrocytic YKL40 is crucial for developmental myelination in the mouse brain. However, its role in de/myelination remains unclear. To investigate this, we generated a tamoxifen-inducible astrocyte-specific YKL-40 knockout mice and subjected them to a well-established cuprizone-induced de/remyelination model. Brain tissue was analyzed using qPCR and immunofluorescence to assess de/remyelination associated markers.

Results: Our preliminary results show that astrocytic YKL-40 loss impacts neuroinflammation, impairs oligodendrocyte precursor cell (OPC) maturation, and affects oligodendrocyte survival, leading to overall worsened demyelination.

Conclusions: These findings indicate a protective role for YKL-40 in de/remyelination and suggest it as a potential therapeutic target for MS and other demyelinating diseases.

Investigating the Stability of Transposable Elements within the Nucleus Accumbens as a Causal Mechanism Required for the Progression of Substance Use Disorders

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Background: Transposable elements (TEs) are mobile DNA sequences that comprise about half of the human genome and emerging evidence suggests that TEs are transcriptionally repressed by KRAB zinc finger proteins (KZPFs), the largest class of mammalian transcription factors. This research investigates the role of TE expression and their KZFP transcriptional controllers in the nucleus accumbens (NAc) as potential molecular mediators of cocaine use disorder (CUD). We use virally delivered synthetic variants of TRIM28, a repressive co-factor for KZFPs, to the NAc

to dysregulate the function of KZFPs in preclinical SUD mouse models. We hypothesize that KZFP-mediated transcriptional repression of NAc TEs enables the progression of CUD and synthetically activating NAc TEs through TRIM28 impedes its pathogenesis.

Methods: Male C57L/6J mice with a jugular vein catheter are purchased from JAX Laboratories to perform intravenous self-administration (IVSA) dose response experiments. We measure baseline drug reinforcements earned for 4 doses of cocaine and then mice undergo intra-NAc stereotaxic delivery of our synthetic TRIM28 and tested again with the same paradigm to directly investigate the effects of KZFP dysregulation on drug reinforcing behaviors. Additionally, male C57BL/6J mice were also used for cocaine conditioned place preference using TRIM28 viral manipulation to test changes in drug rewarding effects.

Results: Preliminary data reveals that inverting the function of KZFPs may decrease drug-seeking behaviors at intermediate doses of cocaine but does not alter the rewarding effects of cocaine.

Conclusions: KZFP-mediated transcriptional control of NAc TEs may contribute to the molecular processes that govern drug seeking behaviors.

Microbiome Modulation of the Host Vaginal Transcriptome in Pregnancy

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Background: The vaginal microbiome (VMB) plays a crucial role in both health and disease. A dysbiotic VMB, characterized by depletion of *Lactobacillus species*, is linked to numerous adverse health outcomes including preterm birth (PTB) and bacterial vaginosis (BV). By analyzing species-specific microbial modulation of the local transcriptome, we aim to deconvolute microbial drivers of vaginal inflammation in both women who delivered preterm and at term.

Methods: Bulk RNAseq transcriptomics was performed on 297 vaginal swabs from multi-racial cohort of pregnant women from the Multi-Omic Microbiome Study-Pregnancy Initiative (MOMS-PI). Differential expression analysis using DESeq2 incorporated maternal covariates including gestational age at sampling, maternal age, race, delivery status (term/PTB), and vaginal microbiome composition.

Results: Women with non-*Lactobacillus crispatus* dominant vaginal microbiomes have significantly upregulated genes associated with inflammatory and immune response pathways, particularly IL-1b and CXCL8. *Prevotella cluster 2*, several related taxa including *Prevotella*

timonensis and *Prevotella buccalis*, previously shown to be associated with preterm birth[1] in this cohort, and "no type" vagitypes, samples without a species comprising > 30% of the relative abundance, resulted in the highest log fold change in inflammatory genes compare to other taxa.

Conclusions: Independent of delivery outcome, non-*lactobacillus* dominant vaginal microbiomes are associated with significantly upregulated local inflammation and immune response pathways within the local vaginal environment. Identifying species-specific influences on the maternal vaginal transcriptome will enhance predictive models of PTB and improve our understanding of host-microbiome interactions in pregnancy.

Does astrocytic S1P-S1PR1 signaling regulate VAPA-dependent ER-organelle membrane contact sites?

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Background: Astrocytes and neurons exhibit cellular crosstalk to bidirectionally provide homeostatic support, regulate development and maturation, and shape neuronal circuitry; however, little is known about the mechanisms which influence astrocyte morphology and intercellular communication. Our lab previously demonstrated that neuronal contact stimulates expression of S1PR1, the astrocytic GPCR which binds the bioactive metabolite sphingosine-1-phosphate (S1P) and drives astrocyte morphology. The downstream mechanisms by which S1PR1 signaling influences astrocyte development and crosstalk, though, are still unknown.

Methods: To further investigate the role of astrocytic S1PR1 in the brain, we performed bulk RNA sequencing from transgenic mice ($S1PR1^{\Delta Ast}$) to knockout S1PR1 in $GFAP^{+}$ astrocytes ($S1PR1^{fl/fl}$;GFAP-Cre). We also utilized qPCR, western blot, and immunofluorescence to quantify mRNA, protein, and astrocyte-specific expression.

Results: Our experiments identified VAPA, an ER-resident protein that forms ER-organelle membrane contact sites (MCSs) as a downstream target and verified a consistent 50% reduction in $S1PR1^{\Delta Ast}$ mice. However, we determined VAPA's reduction is due to a hemizygous gene deletion of VAPA present in unfloxed GFAP-Cre (77.6) mice and independent of S1PR1 KO.

Conclusions: Despite this, we serendipitously discovered that astrocytic S1PR1 independently regulates VAPA expression, as the 50% reduction was seen throughout the brain except in $S1PR1^{\Delta Ast}$ astrocytes. Using an adenoassociated virus approach to knock-out astrocytic S1PR1 in mice postnatally, we indeed observe a significant increase in VAPA expression in astrocytes. Current investigations are underway to determine whether MCSs or their roles are influenced in $S1PR1^{\Delta Ast}$ astrocytes and places a novel role for S1P-S1PR1 signaling as a regulator of MCS organization.

Loss of function of the *Spag17* gene leads to the activation of profibrotic signaling, inflammation, and senescence mechanisms in stromal cells from cervical tissue.

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Background: Female reproductive aging remains a significant challenge in reproductive medicine and is associated with infertility and pregnancy complications. Advanced maternal age is closely linked to the development of fibrosis in the reproductive tract, resulting in uterine and cervical dysfunction. Despite these associations, the molecular mechanisms underlying age-related fibrosis and reproductive decline remain unclear. We have recently shown that the *Spag17* gene is a key regulator of female reproductive aging. To better understand its mechanism of action, we investigated the effect of loss of function of this gene in the mouse cervix.

Methods: Stromal cells and cervical tissue were isolated from wild-type and Spag17 knockout mice and used to assess the activation of profibrotic, inflammatory, and senescence signaling pathways by immunofluorescence and immunohistochemistry.

Results: Profibrotic signaling markers, including SMAD2/3 for the TGF-β pathway, YAP1 for the Hippo pathway, procollagen as a collagen synthesis marker, and ASMA as a myofibroblast detection marker, were all constitutively activated in knockout cells. Additionally, the senescence markers P16, P21, and P53 displayed increased nuclear/cytoplasmic ratios, suggesting activation of senescence mechanisms. Furthermore, a higher number of infiltrated immune cells (CD45+ and F4/80+) were observed in knockout cervix samples.

Conclusions: Our results suggest that Spag17 modulates aging and fibrosis in the cervix by promoting the activation of profibrotic signaling, inflammation, and senescence mechanisms.

Site and Outcomes of lynx1 Allosteric Modulation of α3β4-Nicotinic Receptors with Relevance to Nicotine Use Disorder

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Background: Smoking, maintained by nicotine-seeking behaviors, is a leading cause of preventable death. In the brain, nicotine acts on nicotinic acetylcholine receptors (nAChR). The α3β4-nAChR subtype suppresses somatic nicotine withdrawal signaling by enhancing activity of GABAergic interneurons of the interpeduncular nucleus. The prototoxin lynx1 is highly expressed in these interneurons. Lynx1 allosterically diminishes α3β4-nAChR response, suggesting a role in modulating nicotine withdrawal signaling.

Methods: To define the interactions through which lynx1 exerts its effects and understand its mechanism of action, molecular dynamics simulations were used to identify residues of α3β4-nAChR where lynx1 may interact. We hypothesized that modifying lynx1 binding residues would produce mutant α3β4-nAChR that are less sensitive to lynx1's modulation. Two-electrode voltage-clamp electrophysiology (TEVC) and cell-attached single-channel electrophysiology were used to assess effects of mutating the putative lynx1 allosteric binding site on receptor function.

Results: Several mutations at the site indicated by molecular dynamics decreased the sensitivity of the receptor to lynx1's effects, supporting the hypothesis that lynx1 effects are mediated by this putative site. Other mutants increased sensitivity of the receptor to lynx1. All mutants also diminished ACh-induced function in the absence of lynx1.

Conclusions: Some of the lynx1-interacting residues at the targeted α3/α3 subunit interface correspond with those that contribute to orthosteric agonist binding sites, located at β4/α3 interfaces, possibly revealing a previously-unknown ACh binding site at the α3/α3 interface. These results indicate the site and mechanism by which lynx1 interacts to suppress receptor function, potentially providing a new target for future smoking cessation therapies.

Hydrogen sulfide donor inhibits cisplatin-induced foam cell death in an in vitro model of atherosclerosis

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Introduction: Cisplatin (CDDP) is a widely used chemotherapeutic whose use is associated with long-term cardiovascular morbidity and mortality risk, including acute coronary syndrome (ACS). Pro-inflammatory activation and death of macrophage foam cells (MFC) within the atheroma contribute to plaque destabilization and coronary artery thrombosis. The mechanisms underlying CDDP-induced ACS remain largely obscure. Hydrogen sulfide (H_2S) has been shown to regulate cell survival and reduce the residual inflammatory risk in myocardial infarction.

Methods: Bone marrow-derived monocytes were differentiated into MFC using 30 ng/mL of Macrophage-Colony Stimulating Factor (M-CSF) for 7 days, followed by treatment with 50 µg/mL of OxLDL for 24 hours. Lipid content was assessed using Oil Red O (ORO) staining. The methyl thiazolyl diphenyl-tetrazolium bromide (MTT) assay was employed to determine the cytotoxic effects on MFC subjected to a 48-hour treatment with 10 µM CDDP after a 30-minute pre-treatment with fast or slow-acting H_2S donors, sodium sulfide (Na_2S), or GYY4137, respectively.

Results: Differentiated cells exposed to OxLDL exhibited a significant increase in lipid accumulation compared to untreated cells ($p<0.005$). Na_2S and GYY4137 alone had no impact on cell death. Treatment with CDDP resulted in approximately a 35% increase in cell death, while pre-treatment with GYY4137 decreased MFC death by about 27% ($p<0.005$ vs. control, $p<0.005$ vs. CDDP).

Conclusion: Our results indicate that CDDP may contribute to plaque destabilization by inducing MFC death, which is attenuated with H_2S treatment. Further studies will be conducted to determine the mechanism(s) underlying CDDP-induced MFC death.

Experiential Learning and The Patient Presents With: A Novel Approach to Triplet Oral Boards for Medical Students

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Background: Mock oral examinations provide opportunities to apply medical knowledge in non-clinical, pedagogic environments but are not routinely included in undergraduate medical education curricula. Examinations may occur as multiple cases simultaneously, but they are unrelated. Further, there are limited opportunities for experiential learning in simulation labs despite their ability to bridge the gap between medical knowledge and clinical practice.[3] When included, experiential learning does not occur in conjunction with oral boards, dissociating propaedeutic techniques from the tangible decision-making process of applying, analyzing, and evaluating treatment modalities inherent to simulated learning environments.

Methods: Fourth-year medical students took a pretest. They then participated in 3 oral board-style cases that were nearly identical with subtle variations that led to different diagnoses (diabetic ketoacidosis, thyroid storm, and aspirin overdose) and managements. Cases were reviewed and differences were highlighted. Students then participated in simulation of the 3 cases to reinforce concepts learned during oral board cases. Outcome measurements included posttest performance and completion of critical actions.

Results: Fifteen students participated; mean pretest and posttest scores were 40.5% (SD 9.7) and 95.9% (SD 6.0), respectively ($p < 0.0001$; CI -60.6 – -50.4)). All groups completed the items on the critical actions' checklist in 15 minutes.

Discussion: Traditional oral-board cases may be modified by creating nearly identical cases with subtle differences and supplemented in the simulation lab to reinforce concepts learned. Skills may be applied across specialties. We hope to create a series of cases based off these pilot data and expand the current cases.

Post-Transplant Predictors and Outcomes of Persistent Cholestasis after Liver Transplantation

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Background: Liver Transplantation (LT) is the definitive treatment for end-stage liver disease (ESLD). Rising prevalence of ESLD led to an expansion of donors which was tempered by high-onset of biliary complications, such as post-liver transplant cholestasis (PLTC). While the drivers of PLTC are well studied, little is known of the population characteristics driving its progression. Thus, the objective of the study was to characterize patients with ESLD who develop PLTC to identify factors associated with worse outcomes.

Methods: In a retrospective study, 611 patients who underwent LT at author's institution between 2004-2022 were divided into three groups of cholestasis (normal [402], borderline [146], high [63]) based on alkaline phosphatase (ALP) values (ALP < 120, ALP 120-240, ALP ≥ 240 U/L) at 6 months post-LT. Univariate and multivariate analyses were performed.

Results: Pre-transplant characteristics such as age, body mass index and gender were not associated with degree of cholestasis. ALP levels at 3 months were predictive of borderline and high cholestasis through 36 months ($p < .001$). Patients with primary sclerosing cholangitis as their underlying liver disease were more likely to be in the high group (OR = 3.494, $p = .048$, 95% CI = [1.011, 12.074]).

Conclusion: LT patients with elevated ALP at 3 months post-LT and those with PSC as the underlying liver disease were likely to have persistent cholestasis. A higher mortality or disease burden in the form of longer hospital stay, infection or liver rejection was not clearly associated with high degree of cholestasis in this study.

Cryptococcus neoformans Meningitis with Normal Cerebrospinal Fluid Profile

Bradley Sheffield

Background: Fungal meningitis classically causes pleocytosis, hyperproteinorrachia, and hypoglycorrhachia on CSF analysis. We present a rare case of cryptococcal meningitis lacking these findings.

Case Presentation: A 30-year-old male with no known medical history presented with 3.5 weeks of nausea, vomiting, headache, and back pain. Physical exam revealed cachexia, photophobia, and neck stiffness. Lumbar puncture (LP) yielded no pleocytosis, hyperproteinorrachia, or hypoglycorrhachia. CSF culture was positive for *Cryptococcus neoformans*. The patient was diagnosed with AIDS and treated with amphotericin B, flucytosine, serial LPs, LP drain, and ultimately a ventriculoperitoneal shunt due to persistent elevated opening pressures.

Discussion: Fungal meningitis without pleocytosis is rare and carries a 56% mortality rate. One possible explanation is the patient's immunodeficiency. Normal CSF protein and glucose suggest an intact blood-brain barrier (BBB), which is unusual in meningitis. This may have occurred as *C. neoformans* can bypass the BBB via a transcellular mechanism without causing damage. Additionally, reduced inflammation secondary to host immunodeficiency likely preserved BBB integrity despite infection. It is postulated that persistent ICP elevation can result from antifungal treatment, leading to rapid organism destruction, subsequent obstruction of the arachnoid villi, and decreased CSF reabsorption, causing communicating hydrocephalus.

Conclusion: Normal CSF findings in the setting of meningitis may lead to a false reassurance that there is no infection. Given the high mortality rate of cryptococcal meningitis without pleocytosis, it is critical to initiate empiric antimicrobial coverage when clinical suspicions are high until CSF cultures result.

Chemotherapy-Induced Gastrointestinal Inflammation Enhances Opioid Tolerance

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Background: Recent clinical evidence shows increased opioid-related overdoses in patients diagnosed with colorectal cancer while patients report under treatment for cancer/chemotherapy-related pain suggesting active treatment contributes to opioid tolerance. This study tests the hypothesis that gastrointestinal inflammation induced by administration of the chemotherapeutic agent Irinotecan enhances analgesic tolerance to morphine resulting in increased overdose.

Methods: Opioid tolerance was determined through the warm water tail withdrawal assay in ICR mice treated with either saline, morphine, or Irinotecan+morphine. Irinotecan (75 mg/kg;ip) was administered once a day for 4 days. Morphine treatment commenced on day 3 of Irinotecan administration. Chronic morphine treatment was initiated with 20 mg/kg b.i.d. on day one, 40 mg/kg b.i.d. on days 2 and 3. Tolerance to morphine was tested by challenge doses of 30mg/kg morphine and 100 mg/kg of morphine.

Results: Saline treated mice produced 100% maximal possible effect (MPE) at 30 mg/kg and 100 mg/kg morphine challenge. Morphine treated mice demonstrated tolerance with MPE reduced to 88% at 30 mg/kg. Irinotecan+morphine treated mice were significantly more tolerant with MPE of 54% at 30 mg/kg and 75% at 100 mg/ ($p<0.05$ for both).

Conclusions: Treatment with Irinotecan induced greater tolerance to morphine. We have previously shown that disruption of the gastrointestinal epithelial barrier results in colonic inflammation that exaggerates opioid tolerance. The current study further suggests that chemotherapy-induced inflammation predisposes the development of opioid tolerance and may underlie the clinical findings of increase opioid use disorders in cancer survivors. Further studies

are planned to determine the mechanisms for the loss of epithelial barrier integrity and define the inflammatory pathways leading to opioid tolerance.

Is the VHA Doing It Better? A Ten-Year Analysis of Age and Outcomes in Patients Undergoing Endovascular Aortic Aneurysm Repair

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Introduction: With increasing age, physical resilience declines, increasing vulnerability to the risks accompanying surgery. Frailty, assessed by the validated Risk Analysis Index (RAI), further exacerbates these risks. We set forth to identify relationships between age, frailty, and post-operative endovascular aneurysm repair (EVAR) outcomes in the Veterans Health Care Administration (VHA).

Methods: We retrospectively analyzed the demographics and outcomes of patients who underwent EVAR from January 2010 to December 2019 at a Level 1A VHA Hospital. Patients were grouped by age into 50-65 years, 65-80 years, and 80+ years. Version A of RAI was calculated through retrospective chart review. A standard cut-off (RAI-A > 30) determined frailty. The Student's t-test and Binary Logistic Regression were utilized to statistically examine the groups.

Results: 208 patients underwent EVAR over the period examined. 19.7% (n=41) of patients were between ages 50-65, 67.3% (n=140) between 65-80, and 13.0% (n=27) % were 80 +. 18.75% (n=39) were frail. With Binary logistic regression, we saw no significant difference in post-operative complications, rate of hospital readmissions, loss to follow-up, or 30 day mortality across age groups or frailty classification. Length of hospital stay increased and days to follow-up appointment decreased with frailty classification ($p=0.003$, $p=<0.001$).

Conclusion: Advanced age and frailty status did not predict increased 30-day mortality, post-surgical complications, or hospital readmission. This suggests post-operative support provided by the VHA may mitigate complications that occur in both older and more frail patient populations.

On the detection of population heterogeneity in causation between two variables: Finite mixture modeling of data collected from twin pairs.

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Background: Traditional causal inference often assumes that all individuals in a population share the same causal direction between two traits. However, in fields like psychiatric genetics, such assumptions can mask true underlying heterogeneity. For instance, the co-occurrence of depression and substance use disorder may reflect different causal mechanisms across individuals, where depression causes substance use in some, and others where the reverse is true.

Methods: We introduce the Mixture Direction of Causation (mixDoC) model, which integrates the classical twin Direction of Causation (DoC) model with finite mixture modeling. This hybrid approach allows for population-level heterogeneity in causal direction by estimating class-specific causal paths and mixing proportions using structural equation mixture modeling (SEMM). Simulations were conducted in R/OpenMx across varied conditions, including trait heritability, causal effect sizes, and genetic confounding.

Results: Simulations demonstrated that mixDoC effectively identifies subpopulations differing in causal direction. Model fit statistics (AIC) favored the 4-class mixture model in heterogeneous scenarios, while simpler models performed better in homogeneous data. Classification accuracy improved with increased phenotypic mean differences and causal effect sizes, with entropy values nearing 1 in high-separation conditions. The model also estimated individual-level posterior probabilities for class membership, providing potential for personalized inference.

Conclusions: mixDoC offers a novel framework for disentangling heterogeneous causal relationships in twin data, enhancing our ability to model comorbidity. This method holds promise for advancing precision psychiatry and uncovering individual variability in etiology and treatment response.

The RXFP1 agonist ML290 protects against Doxorubicin-induced cardiomyocyte injury *in vitro*

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Introduction: Doxorubicin (DOX) is a widely used chemotherapeutic associated with dose-dependent related cardiotoxicity, termed DRC. DOX damages cardiomyocytes by driving oxidative stress that initiates inflammatory signaling. The relaxin family peptide receptor 1 (RXFP1) was first identified for its role in the cardiac remodeling characteristic of pregnancy. Relaxin-2 (RLX) is the cognate hormone for RXFP1, and when infused into murine models of ischemic heart failure attenuates cardiac dysfunction. Current heart failure therapies have not proven effective in treating DRC. However, synthetic, long-acting RXFP1 agonists may represent a novel therapeutic modality given their antifibrotic, antioxidant, and anti-inflammatory effects.
We hypothesized that the synthetic RXFP1 agonist ML290 mitigates DOX-induced cardiomyocyte injury.
Our goal was to investigate the cardioprotective potential of ML290 in an *in vitro* model of DRC.

Methods: AC16 cardiomyocytes were treated with 1µM DOX ± 10µM or 40µM ML290 for 24 hours and assessed for oxidative stress (CellROX Red), DNA damage (TUNEL staining), and gene expression (RT-qPCR, n=4). Expression was analyzed via the ddCt ($2^{(-\Delta\Delta Ct)}$) method and normalized to *B2M*. Statistical significance was determined by one-way ANOVA with Tukey's test. Error bars represent the mean ± SEM. P values denoted as **p<0.01, ***p<0.001, ****p<0.0001.

Results: TUNEL positivity, a marker of DNA damage, was higher in DOX-treated cells but reduced by ML290 (Fig. A). DOX also increased ROS, which was attenuated by ML290 (not shown). This was reflected by the expression of oxidative stress genes *SOD2*, *FOXO1*, and *HMOX-1* (Fig. B). DOX upregulated pro-inflammatory genes *CCL2*, *IL-1β*, *IL-6*, and *CASP1; IL-6* and *IL-1β* were attenuated by ML290 (Fig. C).

Conclusion: These findings suggest ML290 protects cardiomyocytes from DOX-induced oxidative stress, DNA damage, and inflammation, highlighting RXFP1 as a potential therapeutic target for DRC.

Characterizing the Novel Quipazine Analog VCU-1012: Unveiling a New Class of Psychedelic Compounds

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Background: Classical psychedelics are currently categorized into 3 classes based on chemical structure. Their respective compounds display unique binding interactions with 5-HT_{2A}R (a G protein-coupled receptor mediating hallucinogenic effects) and distinct pharmacological and therapeutic profiles. Currently, psychedelic research aims to uncover mechanisms of the therapeutic effects of psychedelics and design ligands that more specifically elicit therapeutic over adverse effects. Quipazine -a drug with anti-depressant, hallucinogenic and adverse gastrointestinal effects- was hypothesized to represent a new structural class of psychedelic. Our current work aimed to design quipazine analogs without the adverse gastrointestinal effects mediated by 5-HT_3R while maintaining agonist activity at 5-HT_{2A}R and therapeutic benefits.

Methods:

- In vitro
  - Binding displacement assays with [^{3}H]ketanserin in HEK-293 cells stably expressing h5HT_{2A}R cDNA.
  - Agonist-induced Ca^{2+} mobilization assay in HEK-293 cells stably expressing h5HT_{2A}R cDNA and also with alanine mutations in binding pocket residues.
  - Whole-cell voltage clamp electrophysiology in a tetracycline-inducible Flp-In-293 T-REx cell line.
- In vivo (adult male C57Bl6J mice)
  - Head-twitch response
  - Gut motility assay
  - Forced swim test
  - Frontal cortex dendritic spine density in WT and 5-HT2AR KOs

Results: VCU-1012, a quipazine analog, displays 5-HT_{2A}R binding affinity and agonism, no adverse 5-HT_3R-mediated gastrointestinal effects, and hallucinogenic, neuroplastic, and anti-depressant-like effects in mice. Mutation studies revealed 5-HT_{2A}R residues within the binding pocket mediating this analog's agonist activity.

Conclusions: These results suggest VCU-1012 and potentially other quipazine analogs represent an entirely new structural class of psychedelic with therapeutic potential that can be further investigated for intentional drug design.

Extracellular Vesicles from an In Vitro Model of Preterm Intraventricular Hemorrhage Drive Neuroinflammation in Neonatal Mice

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Introduction: Post-hemorrhagic hydrocephalus (PHH) is a debilitating complication of neonatal intraventricular hemorrhage (IVH), occurring in 40-50% of preterm neonates with severe IVH. PHH is driven by disrupted cerebrospinal fluid (CSF) dynamics, neuroinflammation, ventricular zone (VZ) disruption, and extracellular matrix remodeling. We previously identified increased extracellular vesicles (EVs) in the CSF of infants with IVH and PHH, originating from immune and neural stem cells. This study examines whether VZ-derived EVs contribute to the pathophysiology of IVH/PHH by promoting neuroinflammation. We hypothesized that blood-exposed VZ-EVs activate immune cell subpopulations, contributing to periventricular inflammation.

Methods: Primary neural stem cells from the VZ of postnatal day 4 (P4) C57BL/6 mice were cultured and exposed to 25 µL whole blood for 24 hours, with PBS-treated cultures as controls. Following a 24-hour washout period, conditioned media was collected for EV isolation. EVs were characterized using nanoparticle tracking analysis (NTA), flow cytometry, and proteomics. P4 mice underwent bilateral intracerebroventricular injections of 4 µL EVs (2.25 x 10^9 particles/mL). On post-injection day 7, MRI assessed ventricular volume, while quantitative histological analyses evaluated ventricular wall integrity, choroid plexus function, and inflammatory markers.

Results: NTA revealed a higher concentration of blood-exposed VZ-EVs than control-EVs ($p=0.0465$), with a greater abundance of smaller EVs (50-150 nm). Flow cytometry confirmed EV sorting by size and PKH67 membrane labeling. Proteomic analysis identified enrichment of extracellular matrix remodeling proteins and inflammatory mediators. Differentially expressed proteins ($p<0.05$, Log2FC >1) were linked to cytokine regulation, immune cell differentiation, and TGF-β signaling. Despite no significant difference in ventricular volume on MRI, histological analysis showed increased GFAP+ astrocytes and Iba1+ microglia and macrophages ($p<0.04$) in the periventricular white matter of blood-exposed VZ-EV-injected mice. No differences were observed in choroid plexus transport protein expression (SPAK, NKCC1) or VZ disruption (GFAP, βIV-tubulin).

Conclusion: Blood exposure *in vitro* induces VZ-derived EVs with proinflammatory cargo. When administered *in vivo*, these EVs drive periventricular inflammation, suggesting a role in the

pathophysiology IVH and PHH. Targeting EV-mediated immune activation may offer a novel therapeutic strategy for treating IVH and preventing PHH.

Identifying The Role of Iron In Dendritic Cell Induction of Follicular Helper T Cell Subsets

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Background: Dendritic cells (DCs) are crucial bridges between the innate and adaptive immune systems, capturing antigens, processing them, and presenting them to Tcells. These cells initiate and shape adaptive immune responses. cDC2s present the antigen on MHCII to CD4+ Tcells and influence their differentiation. Follicular T helper cells 13 (Tfh13) are a specialized subset of CD4+ helper T cells that play a crucial role in the development of IgE antibody-producing B cells. The transferrin receptor (Tfr1), is a cell surface glycoprotein that regulates iron uptake.

Methods: *In vitro* Bone Marrow-Derived Dendritic Cells (BMDCs) were exposed to allergens and 4hrs later, these BMDCs were processed for flow cytometry to examine both cellular iron levels and surface Tfr1 expression. *In vivo*, mice were administered allergen intranasally and treated with Ferristatin II, a Tfr1 inhibitor, or Deferiprone, an iron chelator. On day 8, lymphadenectomy was performed and cells were processed for flow cytometry. Tcell polarization to the Tfh13 subset was examined.

Results: First, iron levels were shown to be increased after allergen stimulation and excitingly, a subset of $Tfr1^{hi}$ cDC2s was identified. Ferristatin II and Deferiprone treatment, *in vivo*, decreased Tfh13 induction, while other effector or follicular T cell frequencies were unaffected.

Conclusion: We identified a novel subset of $Tfr1^{hi}$ cDC2, which may influence follicular helper T cell induction, thereby influencing IgE antibody production from B cells.

Regulation of T cell polarization using HIF1-α stabilizer, Roxadustat in MC903-induced Atopic Dermatitis

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Background: Atopic Dermatitis (AD) remains one of the most chronic inflammatory skin diseases and is strongly associated with other atopic diseases like asthma. Though Th2 response is known to be the main humoral response in AD, follicular helper T (Tfh) cells have been identified as mediators in AD pathogenesis. AD presents with increased serum IgE and associated cytokines; IL4 and IL13. HIF1α, an oxygen-dependent transcriptional activator, involved in cellular metabolism plays a major role in regulating immune cell effector functions. HIF1α stabilization inhibits Tfh13 polarization and IgE+ Germinal Center B(GCB)cells. We hypothesized that Roxadustat (FG-4592), a HIF-1α stabilizer would decrease Tfh and IgE+ GCB cell response.

Methods: Auricles of C57BL/6 mice were treated with MC903 and house dust mite for 15 days while measuring ear thickness every other day. Mice started receiving topical treatment with Roxadustat after day six. Mice were humanely euthanized on day 15; organs were harvested and processed for flow cytometry, sectioning and RNA isolation. Statical analyses were performed using Ordinary One-way ANOVA.

Results: Topical treatment with Roxadustat inhibited AD in treated mice group with a reduction in plasma and GCB cell IgE and IgG1 as well as Tfh1 cells, while there was an increase in T follicular regulatory cells. AD-associated genes, MMP12, GATA3 and CD14 were also decreased in Roxadustat treated mice.

Conclusion: Topical treatment of AD with HIF1α stabilizer, Roxadustat in mice is associated with a decreased progression of AD.

School of Dentistry

BCL-2 selective inhibitor venetoclax combined with topoisomerase I inhibitor irinotecan is effective in small cell lung cancer (SCLC)

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Background: Lung cancer is the third most common cancers globally, and small cell lung cancer (SCLC) accounts for 10–15% of all lung cancer cases. Extensive stage (ES)-SCLC has an overall five-year survival rate of ~5%. Although ES-SCLC initially responds well to platinum-based combination chemotherapy, it almost invariably develops resistance over time. Immunotherapy can induce some responses in ES-SCLC, and arlatamab-dlle, a DLL3 targeted bi-specific T-cell

engager, was recently given advanced approval to treat relapsed ES-SCLC. However, ES-SCLC remains a dismal prognosis. Venetoclax is a Bcl-2 selective inhibitor that induces apoptosis by binding to the hydrophobic groove of BCL-2. We previously demonstrated that venetoclax is effective in SCLC with high BCL-2 expression (Lochmann et al., *Clinical Cancer Research* 2018). Irinotecan is an antineoplastic enzyme inhibitor that blocks the topoisomerase I DNA complex, preventing DNA repair and causing double-strand breaks that lead to cell death. It is often given in the relapsed setting as second-line therapy for ES-SCLC.

Aims: We aimed to determine if venetoclax could enhance responses to irinotecan in SCLC preclinical models, and vice versa.

Methods: Venetoclax was combined with irinotecan and SCLC cell viability was evaluated including CellTiter-Glo (CTG), immunoblotting, and in mouse models, including patient-derived xenografts, in vivo.
Results: Our data showed that combining the BCL-2 selective inhibitor venetoclax with irinotecan demonstrated in many SCLC models, enhanced activity over single-agent alone. In vivo, the combination enhanced survival compared to either single-agent.

Conclusion: We demonstrate that combining the BCL-2 selective inhibitor venetoclax with irinotecan could enhance responses and survival in the refractory SCLC setting.

Investigating sensitivity and resistance to proteasome inhibitors in non-small cell lung cancer cells harboring oncogenic mutant p53

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Background: Non-small cell lung cancer (NSCLC) is a common subtype of lung cancer (~80%), with ~50% of tumors carrying a missense mutation in the *TP53* gene (Onc-p53). These mutants lead to the acquisition of oncogenic traits such as tumorigenesis and chemoresistance, as well as vulnerabilities targeted for treatment. We have shown that NSCLC cells expressing Onc-p53 exhibit elevated proteasome activity which serves as a vulnerability for proteasome inhibitors (PIs) to further augment proteotoxic stress, leading to the accumulation of reactive oxygen species (ROS). Despite initial effectiveness, these cells often develop resistance to PIs, with the underlying mechanism remaining obscure.

Methods and Results: We have demonstrated that bortezomib (BTZ)-induced ROS initiates a cascade including the activation and nuclear translocation of NRF2, followed by the induction of ATF3, BH3-only NOXA, and apoptosis. Furthermore, the combination of BTZ with BH3-mimetic inhibitors synergize with carboplatin, a standard of care chemotherapy, to selectively kill Onc-p53 NSCLC cells *in vitro* and *in vivo*. We now show that the prior inductions are strongly suppressed in BTZ-resistant cells. Bulk-RNA sequencing identified the induction of PD-L1, suggesting that immune checkpoint induction may play a role in the resistance to PIs.

Conclusion: Our findings suggest that resistance to PIs in Onc-p53 NSCLC tumors involves adaptations that reduce proteotoxic stress and may leverage immune checkpoint pathways. However, combining PIs with BH3-mimetics effectively restores cytotoxicity even in BTZ-resistant cells, suggesting that using BH3-mimetics could offer an approach to overcome PI resistance, supporting the potential for PI-based targeted combination therapies in NSCLC patients.

School of Pharmacy

"Deconstruction-Reconstruction-Elaboration": A Structure Activity Relationship Approach for Rational Design of FOSL1/cJUN Inhibitor to Treat Head and Neck Squamous Cell Carcinoma

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Background: Head and neck squamous cell carcinoma (HNSCC) is a prevalent cancer type with poor prognosis due to resistance and recurrence, driven by cancer stem cells (CSCs).[1,2] T5224, a small molecule AP-1 (cFOS) inhibitor disrupts DNA binding and has reached phase II clinical trials for rheumatoid arthritis.[3,4]Recent studies have also shown its potential in suppressing tumors and overcoming CSC-induced chemoresistance by FOSL1/cJUN inhibition.[5,6] However, its low efficacy has limited its therapeutic utility. Though it binds to FOSL1 heterodimer, the pharmacophore required for binding is unknown. Thus, we aim to identify the minimum structural features of T5224 required for binding to FOSL1/cJUN DNA binding domain and decipher its pharmacophore.

Method: A deconstruction-reconstruction-elaboration approach was employed for the design of compounds. Designed compounds were synthesized and thoroughly characterized, and their purity was determined by HPLC. Microscale thermophoresis was utilized to screen for binding and their transcription inhibition activity was evaluated using a luciferase reporter assay.

Results: Eleven analogs were designed, synthesized and screened via microscale thermophoresis, identifying four that bind to heterodimer. These four were further tested using luciferase assay to understand the structural features required for transcriptional inhibition. While either benzisoxazole or acid group is required for binding, both groups are required for AP-1 induced luciferase activity inhibition and FOSL1 activity suppression. Molecular docking studies also predicted similar pharmacophores for high-affinity DNA binding to AP-1.

Conclusions: Overall, this study highlights the key structural features of T5224 that can be further refined to identify promising compounds targeting FOSL1/cJUN in HNSCC.

Orally Inhaled Lipid-based Combination Therapy for the Treatment of Osteosarcoma Lung Metastasis

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Background: Osteosarcoma (OS) is the most prevalent primary bone malignancy, metastasizing almost exclusively to the lungs. Systemic gemcitabine (GMT) is the second line therapy for OS lung metastasis (OSLM), but it has limited efficacy due to poor lung distribution. Orally inhaled

GMT is in clinical studies and has been shown to upregulate the apoptotic Fas receptor (FasR) expression in OS cells in the lungs but fails to eradicate lung metastases due to its poor lung disposition. Traditional liposomal GMT formulations offer improved lung safety and retention, but struggle with storage stability and drug loading. *We hypothesize that liposomal formulations of metal (M)-gemcitabine(GMT) (**L-M:GMT**) will safely enhance treatment outcomes in clinically relevant models of OSLM when locally administered to the lungs.*

Methods: L-Mn:GMT were prepared using an active loading method in a single-step scalable way and evaluated for hydrodynamic diameter, PDI, zeta potential and drug loading using Light Scattering and HPLC analyses.

Results: Results showed that our L-Mn:GMT significantly increased drug loading (13% vs. 6% for non-metal complexed) and demonstrated remarkable storage stability (less than 5% drug leakage over six months). In vitro studies revealed that L-Mn:GMT maintains cytotoxicity and FasR rescue in OSLM cells. Additionally, no adverse effects were observed in a tolerability study using healthy mice.
Conclusions: We demonstrated that the Mn^{2+} complexation is a potential strategy to improve the drug loading and to enhance the storage stability. These findings open the opportunities for L-Mn:GMT to support standard of care therapy in OSLM.

"ON! Original Flavor Oral Nicotine Pouch Characterization: Biorelevant In Vitro Nicotine Release Apparatus Assessment"

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Background: Oral nicotine pouch (ONP) use is rising. The sales of ONPs in 2019 were 126 million units, increasing to 808 million units in 2022. Understanding ONP in vitro release is critical for assessing exposure to ONP products.

Methods: The commercial brand ON! ONPs with nicotine label claims of 2, 4, and 8 mg, were evaluated in vitro for cumulative nicotine release using the bidirectional transmucosal apparatus (BTA) for 90 minutes. Nicotine quantification was performed by HPLC-PDA. For pH determination, ONP samples were prepared in water or artificial saliva (pH 6.8) with measurements for 30 minutes. BTA results were compared to ON! ONP in vivo data to access relevance.

Results: The cumulative release across all ON! ONP nicotine concentrations were greater than 85% and maximum release occurred within 30 minutes. The pH of ON! original flavor ONPs in water was 8.4 to 9.4. The pH in artificial saliva was 7.3 to 8.5. The pH remained constant over sampling time. The 8 mg ON! ONPs were found to have a lower pH than 2 and 4 mg. The 4mg ON! original ONPs had a higher pH than 4 mg ON! mint. The BTA and in vivo data both showed maximum nicotine concentrations around 30 minutes.

Conclusion: In vitro nicotine release was acceptable under United States Pharmacopeia guidelines. ON! ONPs do not utilize pH change during nicotine delivery and pH is influenced by flavor. More in vivo data is required to establish an in vitro in vivo correlation for ONPs.

Interplay Between HIV and Methadone: Effects on Chemokine Dysregulation and Neuroinflammation

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Background: HIV infection and opioid use disorder (OUD) frequently co-occur, with opioids exacerbating HIV-related neuroinflammation. Chemokines, regulators of immune cell trafficking and activation, mediate this inflammation. Methadone, while effective for OUD treatment, is an opioid that may contribute to neuroinflammation among HIV patients. This study examines methadone's effects on chemokine dysregulation in the striatum, exploring the interaction between HIV, opioids, and neuroinflammation.

Methods: HIV-1 Tat transgenic female mice (n = 36) were divided into four groups: Tat-/placebo, Tat-/methadone, Tat+/placebo, and Tat+/methadone. Following a 14 day induction of Tat, a neurotoxic HIV protein, methadone (25 mg/kg/day) or placebo was administered via osmotic pumps for 5 days. Chemokine levels were measured using a LegendPlex panel. Data were analyzed with Kruskal-Wallis tests, Dunn’s post-hoc tests, and exploratory principal component analysis (PCA).

Results: Tat and methadone significantly altered chemokine expression in the striatum. PCA identified four chemokines—CCL11, CCL17, CXCL1, and CCL22—as key contributors to group differentiation based on opioid and Tat status. Kruskal-Wallis and Dunn’s tests confirmed significant dysregulation of these chemokines. CCL11, CCL17, and CXCL1 exhibited the greatest dysregulation in the Tat+/Methadone group, indicating additive effects of Tat and methadone. CCL22 was primarily influenced by methadone, with dysregulation observed in both methadone-treated groups regardless of Tat status.

Conclusion: These findings suggest methadone treatment, although effective for OUD, may inadvertently exacerbate HIV-related neuroinflammation through chemokine dysregulation, particularly within the striatum. Future research should explore methadone’s broader impacts on HIV-associated neuropathology.

Development of a PLX Liposomal Formulation using a Continuous Manufacturing Approach and Design of Experiments (DOE)

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Purpose: This study aims to develop a clinically translatable liposomal PLX-3397 (L-PLX) suspension for nebulizer dosage forms, targeting macrophages in solid tumor treatment. A continuous microfluidic manufacturing approach was used.

Methods: L-PLX was formulated via a microfluidic method, and its critical quality attributes (CQAs) including hydrodynamic diameter (HD), polydispersity index (PDI), and zeta potential were characterized using light scattering. Drug encapsulation efficiency (EE%) and drug loading (DL%) were analyzed via HPLC. An A-Optimal Design of Experiments (DOE) with 24 runs was used to optimize key critical material attributes (CMAs) such as the PLX-to-lipid ratio (5:1, 20:1) and aqueous medium (PBS, normal saline), along with critical process parameters (CPPs) like flow rate, temperature, and flow rate ratio (FRR).

Results: The predictive model demonstrated a high level of accuracy (R-squared = 0.995493, Adjusted R-squared=0.990575). The most influential factors were FRR, lipid-to-drug ratio, and temperature. The optimal formulation was identified with a lipid-to-drug ratio of 5:1, PBS as the aqueous medium, FRR of 5:1, and no heating. Experimental validation showed consistency between predicted and actual outcomes for particle size, PDI, zeta potential, EE%, and DL%. Tangential Flow filtration as purification for continuous manufacturing was proceeded for stability testing, which confirmed that the formulation remained stable for three months, maintaining consistent particle size, PDI, and zeta potential in the sterile suspension containing 0.5% ethanol.

Conclusions: An optimal L-PLX formulation with a suitable target product profile was identified. Future studies will focus on kinetic and dynamic testing, followed by aerosolization using a handheld nebulizer.

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Nanoformulation-Based Targeted Therapy Combined with Immunotherapy for Enhanced Treatment of Triple-Negative Breast Cancer

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Background: Triple-negative breast cancer (TNBC) is the most aggressive subtype of breast cancer with limited treatment options and poor survival outcomes. Chemotherapy remains the standard of care for TNBC, but has significant drawbacks, including off-target systemic toxicity and drug resistance, leading to an overall low survival rate. In this study, we are proposing to use a combination treatment of nano-formulated targeted therapy with an immunotherapy and hypothesize that this approach will improve efficacy through multifaceted approach and reduce toxicity by selectively targeting molecular pathways involved in TNBC.

Methods: Four targeted drugs from the National Institute of Health Cancer Therapy Evaluation Program were evaluated for cytotoxicity in vitro across TNBC human/mouse cell lines and patient-derived xenograft (PDX) cells. Western blot analysis was used to assess molecular target expression and pathway inhibition. In vivo studies will first assess the efficacy of the targeted drugs monotherapies, and then the best two drugs will be selected for combination studies with immunotherapy, in both free drug form and nano-based delivery systems.
Results: In vitro results showed strong cytotoxic efficacy for all drugs, with IC50 values below 1 μM in most cell lines and western blot analysis demonstrated differential expression of key molecular targets with treatment. Preliminary in vivo monotherapy studies showed limited tumor growth reduction, with the exception of Belinostat.

Conclusion: In conclusion, while in vitro data suggest strong potential, further in vivo studies are needed to optimize dosing and assess the therapeutic benefits of combination therapy.

Lipid Nanoparticle-driven Classical Activation of Circulating Inflammatory Monocytes as a Therapeutic Tool for Metastatic Breast Cancer

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Background: Breast cancer is the most common type of cancer affecting women globally. Metastatic breast cancer remains incurable and therapeutic options remain limited, in particular, when cancer has spread to the central nervous system. Inflammatory monocytes play a crucial role in this metastasis, they expand in the bone marrow of cancer patients, circulate in great numbers in peripheral blood, and are recruited into tumors by tumor-derived chemokines. We have previously shown that transient *ex vivo* treatment of monocytes with recombinant interferon gamma (IFN-γ) followed by adoptive transfer into primary breast tumor-bearing mice leads to recruitment to primary tumors and anti-tumor activity. Lipid nanoparticles (LNPs) are one of the most successful nano-delivery vehicles that enable efficient delivery of various therapies, such as RNA. LNPs have tunable physical and chemical characteristics, making them flexible to design monocyte-targeted drug delivery systems.

Methods: First, we will formulate LNPs using the ethanol injection method, characterize and then evaluate monocyte programming activity of LNPs upon gradient isolation. Next, we will determine the ability of LNP-programmed monocytes to accumulate and reduce tumor burden in primary and metastatic syngeneic tumor models.

Results and Conclusion: We have formulated LNPs with the critical target product profile (CTPP) for downstream applications: hydrodynamic diameter < 150 nm, polydispersity index (PDI) < 0.2, zeta potential between -30 and +30 mV, and encapsulation efficiency (EE%) > 90%. Furthermore, we achieved at least 80% LNP-transduced human monocytes. Ongoing experiments are testing the efficiency of transfection on primary murine monocytes and programming effects.

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Utilization of Massey Support Shared Resources: Flow Cytometry Shared Resource.

Reverse engineering of the Sublocade® buprenorphine *in-situ* forming implant

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Purpose: Sublocade® is a biodegradable *in-situ* forming implant (ISFM) for sustained buprenorphine delivery, treating opioid use disorder with monthly dosing. It contains 18% w/w buprenorphine, 32% w/w PLGA, and 50%w/w NMP, utilizing Atrigel® technology. PLGA complexity and absence of standardized *in vitro* release testing (IVRT) makes generic development challenging. This study aims to characterize PLGA properties and understand buprenorphine release to aid generic development.

Methods: PLGA was purified from Sublocade® using Garner et al. (2015) method, optimizing the DCM to hexane/ethanol ratio. Purity was confirmed using Gel Permeation Chromatography (GPC-MALS), and PLGA characteristics such as molecular weight (MW), Lactic/Glycolide (L/G) ratio, end groups were evaluated by NMR spectroscopy (^{1}H, ^{13}C). The release of buprenorphine was assessed using platform shaker and USP 2 with various depot formation methods.

Results: PLGA recovery using hexane/ethanol (80/20 v/v) was 92%. GPC-MALS analysis revealed the PLGA number-average and weight-average MW of 11.7 kDa and 12.2 kDa, respectively. Quantitative NMR analysis indicated a L/G ratio of 52/48, blockiness of 2.03, and carboxyl end group. Furthermore, *in vitro* drug release studies showed that the shaker and paddle-over-basket methods could not consistently reproduce the depot shape. During phase inversion, NMP diffuses out of the polymer matrix, crystallizing buprenorphine due to its low aqueous solubility. A novel adapter in the USP II apparatus revealed biphasic release, with 80% of buprenorphine released in 2.5 months.

Conclusions: This study characterizes Sublocade® PLGA through reverse engineering. The novel adapter for IVRT serves as useful tool for understanding drug release mechanism.

Pre-Systemic Metabolism of EMIQ, a Potential Therapeutic for Myotonic Dystrophy Type 1, in Human Intestinal S9

Purnajai Srivijay S V, Phillip M. Gerk

Background: Quercetin can selectively inhibit transcription of toxic CTG repeats in the DMPK gene responsible for myotonic dystrophy type 1 (DM1). However, its low bioavailability limits therapeutic efficacy. Enzymatically Modified Isoquercitrin (EMIQ), a glycosidic modification of quercetin with up to 10 glycosyl moieties, improves bioavailability but lacks concrete metabolic data needed for accurate oral dosing regimens.

Methods: EMIQ, isoquercitrin (a monoglucoside of quercetin), or quercetin (5 μM) were incubated for 4 hours with/without human intestinal S9 (HIS9) and/or uridine diphosphate glucuronic acid (UDPGA). A developed LC-MS method quantified quercetin and isoquercitrin in biorelevant matrices.

Results: Quercetin's half-life was around 5 hours with/without HIS9 but became undetectable after 60 minutes with HIS9+UDPGA. Isoquercitrin with just HIS9 rapidly decreased while quercetin formed steadily; however, with HIS9+UDPGA, isoquercitrin disappeared more rapidly with quercetin being nearly undetectable. EMIQ without enzymes maintained isoquercitrin at 1.5 μM with no quercetin detected. EMIQ with HIS9 showed isoquercitrin peaking at 5 μM (60 minutes) then decreasing, while quercetin increased at a rate of 430 nM/hr. With HIS9+UDPGA, EMIQ released isoquercitrin, peaking at 3 μM around 30 minutes, and low, transient quercetin concentrations were observed.

Conclusions: These findings demonstrate: 1) rapid quercetin glucuronidation; 2) HIS9-mediated isoquercitrin hydrolysis forming quercetin, subsequently undergoing glucuronidation with UDPGA; and 3) HIS9-mediated EMIQ hydrolysis releasing isoquercitrin and quercetin. This preliminary study provides insights into pre-systemic metabolism of these compounds in the intestinal environment. Future research on EMIQ's metabolic profile can aid development of DM1 therapeutics and benefit other conditions given quercetin's wide applications.

Pre-formulation Considerations of Ketone Ester as an IV Infusion for TBI

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Background: Traumatic Brain Injury (TBI) is a major global health concern with no effective pharmacological treatments to mitigate mortality. Ketone esters (KE) have demonstrated neuroprotective potential and may serve as an alternative energy substrate for the injured brain. This study aimed to assess stability and hydrolysis of KE and plasticizer leaching profile, as a preliminary step toward evaluating its pharmacokinetics in a TBI rat model.

Methods: Three studies were conducted: (1) Stability: KE formulated in sterile water and stored in glass containers was evaluated under room temperature (25°C) and refrigerated (4°C) conditions over 96 hours. (2) Hydrolysis: KE was incubated at varying concentrations in fresh whole human blood at 37°C with esterase inhibitors to assess enzymatic degradation. (3) DEHP Leaching: KE solutions were infused through PVC IV bags at different flow rates, and DEHP content was quantified to evaluate plasticizer leaching.

Results: KE remained chemically stable for 96 hours under both storage conditions with no significant degradation ($p = 0.5084$). Hydrolysis studies showed a concentration-dependent degradation pattern, with faster hydrolysis observed at higher KE concentrations. DEHP leaching increased with higher flow rates but did not reach statistical significance ($p = 0.1075$).

Conclusions: KE IV formulations are stable and exhibit concentration-dependent hydrolysis in blood. While DEHP leaching shows an increasing trend with flow rate, the differences was not

statistically significant. These findings support continued development of KE as a parenteral therapy in TBI.

The Impact of Gene-Drug Interactions on Diabetes Outcomes

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Rationale: Diabetes mellitus is one of the top 10 causes of morbidity and mortality among older adults. Glucose lowering agents such as sulfonylureas, have proven to be effective in decreasing blood glucose levels. However, interindividual variability in pharmacodynamic and pharmacokinetic genes may influence the safety and efficacy of sulfonylureas. Thus, the application of pharmacogenomics to optimize antidiabetic medications may help to improve the pharmacotherapeutic management of diabetes. Unfortunately, sulfonylureas cause recurrent episodes of severe hypoglycemia which are associated with depression and cognitive deficits. Therefore, the goal of this study is to evaluate if Single Nucleotide Polymorphisms (SNPs) in CYP2C9 influence the safety and efficacy of sulfonylureas.

Methods: 130 older adults were recruited via community clinics into the TAPH study. The Mini-Mental State Examination (MMSE) and Patient Health Questionnaire-4 (PHQ-4) were obtained via the NIH-Toolbox Cognitive Batteries. CYP2C9 variants (*2, *3, *5, *11) were assessed via genotyping on the QuantStudio 12K Flex system. Statistical analyses were performed on SPSS 29.

Results: CYP2C9 *2, *3, and *5 alleles were not associated with MMSE or PHQ4 Scores. However, CYP2C9 *11 alleles were associated with MMSE scores (WT=25, *11=27.78, and *11/*11 =29). One participant with *11 genotype was taking a sulfonylurea. We lacked sample size to conduct the gene-drug interaction on MMSE or PHQ4 scores.

Conclusion: Understanding the impact of gene-drug interactions on diabetes outcomes holds the potential for limiting adverse drug events that are associated with pharmacotherapy.

Enhancing mRNA- lipid nanoparticles formulations to improve transfection efficiency in macrophages and dendritic cells in cancer immunotherapy

Yasir Alshehry, Matthew Fernandez, Raneem Aldaqqa, Asma Al-Terawi, Douglas Sweet, Sandro da Rocha

Background: Cancer remains a significant global health challenge, spurring the development of novel therapies. Messenger RNA (mRNA) lipid nanoparticles (LNPs) show great promise in cancer immunotherapy. However, efficient transfection of immune cells like macrophages and dendritic cells (DCs) remains a key hurdle.

Aims: This study aims to optimize mRNA-LNP formulations to enhance cancer immunotherapy.

Methods: We systematically evaluated three key components of LNPs—ionizable lipids, phospholipids, and sterols—by adjusting their molar ratios. In vitro experiments on macrophages and DCs, along with in vivo assessments, were used to evaluate transfection efficiency.

Results: Among six ionizable lipids tested in RAW264.7 and DC2.4 cell lines, SM-102 demonstrated significantly improved transfection efficiency in both macrophages and DCs. In vivo studies with luciferase mRNA-loaded LNPs showed increased luciferase expression when using SM-102 and ALC-0315. The phospholipid DOPE outperformed DSPC in enhancing transfection efficiency. Furthermore, in the sterol component, increasing the molar ratio of β-sitosterol to 19.5% improved mRNA delivery in DCs, while a lower cholesterol ratio (19%) also enhanced transfection. While β-sitosterol alone reduced transfection in DCs, it significantly boosted efficiency in macrophages. The optimal formulations, including SM-102, DOPE, and β-sitosterol, demonstrated the highest efficacy both in vitro and in vivo.

Conclusions: Modifying lipid composition and molar ratios significantly impacts mRNA-LNP transfection. The optimized formulations show promise for improving the delivery of therapeutic agents to macrophages and DCs, offering a potential breakthrough in cancer immunotherapy.

Leveraging Chemo-Immunotherapy to Remodel the Tumor Microenvironment and Enhance Treatment Efficacy in Osteosarcoma Lung Metastases

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Background: Osteosarcoma (OS) is the most common primary bone cancer across all ages, frequently metastasizing to the lungs. At diagnosis, 20% of OS patients present with gross OS lung metastases (OSLM), while most harbor undetectable micrometastases. Despite systemic chemotherapy and experimental therapies like immune checkpoint inhibitors, the 5-year survival rate for OSLM remains low (20-30%), making it the leading cause of OS-related mortality. There is an urgent need for therapies that shift the OSLM tumor microenvironment (TME) toward an immunogenic state.

Gemcitabine (GMT) has shown limited systemic efficacy in relapsed OSLM, while pulmonary administration (PA) has reduced tumor burden but did not eradicate it.

Methods: We propose combining inhaled GMT with colony-stimulating factor-1 receptor inhibitors (CSF-1Ris), such as pexidartinib (PLX-3397), to target tumor-associated macrophages (TAMs), both delivered via PA. GMT increases Fas expression on tumor cells, promoting apoptosis, while CSF-1Ris shift TAMs to an inflammatory M1-like phenotype.

In vitro, GMT upregulated Fas expression in OSLM cells grown both as monolayer, and in a 3D multicellular tumor spheroid (MCT) model, GMT increased Fas expression, while PLX shifted macrophages from M2 to M1. *In vivo*, Balb/c mice with OSLM received PA GMT (5 mg/kg weekly for 2 weeks) and PLX (2 mg/kg every other day for 3 weeks), significantly reducing tumor burden. GMT enhanced Fas expression, and PLX promoted an anti-tumorigenic M1-like TAM phenotype.

Results and Conclusions: Our findings demonstrate that PA chemo-immunotherapy effectively remodels the TME, with a clinically relevant 3D model aiding translation of these therapies to OSLM treatment.

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Continuous Manufacturing of Liposomal Gemcitabine for Local Lung Administration in the Treatment of Osteosarcoma Lung Metastases

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Background: Osteosarcoma (**OS**) metastasizes primarily to the lungs and has no curative pharmacological treatment. Systemic gemcitabine (**GMT**) is used as a second line chemotherapy for the treatment of OS lung metastases (**OSLM**) that is refractory to standard of care or disease relapse but exhibits limited response rates (10%). Aerosolized GMT is being investigated in clinical trials. However, challenges remain, as free aerosolized GMT has a short lung half-life (1 hr). The objective of this work was to further understand the molecular and overall effect of locally administered GMT in a model of OSLM and develop a liposomal GMT **(L-GMT)** formulation for inhalation using a scale independent microfluidic manufacturing strategy.

Methods: L-GMT was prepared using a NanoAssemblr® Ignite™. Light scattering and HPLC was used for critical quality attribute **(CQA)** assessment. In vitro expression of Fas receptor was analyzed with flow cytometry **(FC)** and MTT assay assessed cell viability. An OSLM BALB/c mouse model (K7M2-tdt-luc cells) was used, and mice were treated with free GMT (5 mg/kg) via pulmonary administration (**p.a.**). Tumor burden was assessed via IVIS.

Results: We achieved L-GMT with targeted CQAs. In vitro activity of GMT and L-GMT are statistically equivalent. In vivo experiments show the ability of free GMT to elevate % of Fas+ OSLM cells but fails to eradicate the tumor.

Conclusions: This project shows that continuous manufacturing of L-GMT maintains the ability to enhance Fas expression in an in vitro OSLM model, thus holding the potential to overcome limitations of inhaled GMT in free form.

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Massey or ACS-IRG Supported Pilot: No

Utilization of Massey Support Shared Resources: Cancer Mouse Models Core

School of Education

Centering Student Voices: A New Measure to Amplify Working Learner Perceptions of Supervisory Support

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Background: In 2024, an interdisciplinary team at Virginia Commonwealth University (VCU) developed the Student Supervisor Support Measure to assess working learner (i.e. student employee) perceptions of the support received in student-supervisor relationships (SSRs). This research details a second pilot conducted with the Work+ Collective, a network of higher education institutions, to further test the measure's reliability and gather student feedback.

Methodology: The survey was conducted among working learners at four institutions: VCU, Arizona State University, University of Texas–San Antonio, and University of Michigan–Dearborn. Respondents (n = 298 complete of 538 partial) rated SSRs using the support measure and provided qualitative feedback on supervisory behaviors and the support definition itself.

Results: The measure demonstrated statistically significant reliability with high correlations among questions. Average support scores were positive, indicating strong supervisory support, and areas for improvement were noted. The highest student-rated areas included supervisors' commitment to student goals and honest feedback, while the lowest included adaptability and supporting career readiness.

Key supportive behaviors included personal support, effective communication, and creating a positive working environment. Commonly identified unsupportive behaviors were inconsiderate actions, poor communication, and unavailability. Most students did not report unsupportive behaviors. The definition of support was well-received and students suggested enhancements to include holistic support for well-being and more empathetic relationships.

Conclusions: This survey measure continues to demonstrate reliability for further use. Student feedback highlighted the need for revision to achieve greater clarity and include empathy and well-being as key components of supervisory support.

Gender Racialized Education: Parental Expectations and the Academic Trajectory of Black Males

Joyice Robinson

Background: Parental educational expectations significantly shape children's academic trajectories, particularly influencing reading and math performances. However, there is limited research examining these relationships among African American children, especially considering systemic racism and gender differences. This study investigates the reciprocal effects between parental educational expectations and academic achievement among Black children from Kindergarten to Grade 5, focusing on gendered dynamics.

Methods: Data from the Early Childhood Longitudinal Study, Kindergarten Class of 2011 (ECLS-K: 2011), including 2,396 African American children, were analyzed. Cross-lagged panel modeling (CLPM) evaluated the bidirectional associations between parental expectations and academic performance in reading and math at Kindergarten, Grade 3, and Grade 5, controlling for poverty, gender, and parental education.

Results: Parental educational expectations and reading performance exhibited a significant reciprocal relationship, particularly robust from Kindergarten to Grade 3. High parental

expectations positively predicted higher reading achievement, while academic success also influenced parental expectations. Contrary to expectations, no significant gender differences were found in parental educational expectations at Kindergarten.

Conclusions: The findings underscore the critical role of early parental educational expectations in promoting academic success for African American children. The reciprocal dynamics observed suggest interventions should focus on fostering high parental expectations early to counter systemic educational disparities. Future research should explore these relationships further into adolescence and consider additional factors like teacher perceptions and institutional resources.

Promoting Posttraumatic Growth Following Traumatic Job Loss Using an Acceptance and Commitment Therapy Framework

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Background: The primary objective of this research is to explore the relationship between posttraumatic stress, psychological flexibility, career adaptability and posttraumatic growth (PTG) among individuals who have experienced a traumatic job loss. Background research has indicated that sudden or undesirable career changes are connected to lower adaptability skills (Rudolph & Zacher, 2021). Trauma has lasting effects on various populations' ability to thrive in long-term careers (Prescod & Zeligman, 2018; Kim & Klose Smith, 2021). Additional studies have indicated a strong connection between psychological flexibility, posttraumatic stress, and career adaptability (Prescod & Zeligman, 2018; Russo et al., 2024).

Methods: The researchers are implementing a cross-sectional survey design to capture a specific experience of participants using a community sample of approximately 250 people. This study utilizes a mixed-methods approach to further understand the effects of job loss through assessments and participant language. Research will be collected using the CloudResearch and QuestionPro online platforms. Scales used include the Posttraumatic Growth Inventory, Impact of Event Scale-Revised, Comprehensive Assessment of Acceptance and Commitment Therapy Processes, and the Career Adapt-Abilities Scale, along with researcher created questions on financial stress and trauma history.

Results & Conclusions: Results are pending as the survey was launched last week. The researchers expect to have comprehensive results and interpretations by the date of the symposium. Conclusions will be provided by the date of the symposium as well. Based on the literature review, researchers expect to see a positive relationship between psychological flexibility, career adaptability, and posttraumatic growth. This provides strong implications for counseling and fostering these skills in therapeutic settings.

Counselors' Role in Supporting LGBTGEQIAP+ Teens Living in the Foster Care System

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Background: Queer youth in the United States are overrepresented and simultaneously unseen in the foster care system. They experience more negative mental health outcomes than their non-queer peers, and the child welfare system does not always provide safe or affirming care for these marginalized youth. LGBTGEQIAP+ teens are placed in congregate care at high rates and face a myriad of challenges in these settings that exasperate existing mental health concerns. This poster examines the injustices of out-of-home care and the maltreatment that gender and sexual minority youth experience in the foster care system, as well as exploring factors that improve outcomes. Strategies for counselors to effectively to work with youth in this population are highlighted, including affirming care, self-compassion, and trauma-informed perspectives.

Methods: Researchers conducted a systematic literature review to assess for current outcomes, protective factors and effective treatment implementation for this population.

Results: The literature review resulted in two main foci for improving the mental outcomes of LGBTGEQIAP+ youth in the foster care system, building affirming systems of care and effective mental health treatment. Strategies for building affirming systems include connection to resources, queer affirming placements and comprehensive training for service providers. Effective mental health treatments include affirming care practices, self-compassion and trauma-informed care.

Conclusions: To improve the mental health outcomes for these youth, implementation of affirming care strategies whenever possible and systemic reform is called for. As mental health professionals, it is imperative to recognize the needs of these vulnerable adolescents and respond appropriately.

Strengthening Family-Professional Partnerships: A Framework for Action

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Background: Partnerships between families and professionals are essential for the positive development of young children, especially in early childhood education (ECE), early intervention (EI) and special early childhood education (ECSE). However, the way family empowerment is conceptualized and implemented in these areas is inconsistent, which can lead to fragmentation of practice. This conceptual study proposes a comparative framework for examining the essential elements of family empowerment in these service models.

Method: The framework was developed through a synthesis of theoretical and empirical literature, including published research on policy papers, recommended practices and family-centred service delivery. Key dimensions identified include roles and responsibilities of families and professionals, service planning mechanisms (e.g. IFSP, IEP), access to resources, and cultural responsiveness.

Result: The analysis reveals common and domain-specific strategies for implementing family empowerment. All three areas emphasize cooperation and decision-making, but differ in how formal structures guide family participation. Cultural sensitivity and continued access to support networks become key factors influencing the success of these partnerships.

Conclusion: This conceptual framework lays the foundation for improved collaboration between families and professionals in the context of early childhood. It highlights feasible areas where practice can be improved, including better coordination of services, inclusive planning and policy development. The framework also sets the stage for future empirical research and practice-based applications aimed at enhancing equitable, sustainable engagement with diverse families.

Resilience in the Face of Adversity: Leveraging Communal Strengths of Black Adolescents Navigating Systemic Racism and ACEs

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Background: Black adolescents in urban environments face disproportionate exposure to adverse childhood experiences (ACEs), compounded by the persistent effects of systemic racism. Traditional ACE frameworks often neglect the intersectionality of racial trauma and overlook community strengths. This study centers Black youth experiences through Black liberation psychology and Indigenous wellness frameworks, advocating for strength-based, culturally responsive interventions.

Methods: A comprehensive traditional literature review was conducted, integrating research on ACEs, developmental neurobiology, systemic racism, Black identity development, and communal resilience. The review drew from interdisciplinary sources to explore the biopsychosocial impacts of ACEs and highlight empowerment-based approaches.

Results: The review revealed that Black youth demonstrate significant resilience, largely facilitated by cultural practices (e.g., hip-hop, Black history knowledge), community mentorship, and spiritual grounding. These communal strengths serve as protective factors against trauma-induced outcomes. Furthermore, culturally responsive counseling practices and Indigenous wellness models offer practical strategies for healing, growth, and identity development among Black adolescents.

Conclusions: While Black adolescents are disproportionately affected by ACEs and systemic racism, a strengths-based framework reveals pathways to wellness rooted in culture, community,

and liberation. Counselors and mental health professionals must adopt culturally affirming, historically informed practices that honor these youths' lived experiences. Advocating for systemic change, restorative environments, and identity-affirming interventions is critical to fostering long-term well-being and resilience.

College of Humanities & Sciences

Size and Composition Tunable Optical Properties of Solution Processed Ternary $Ge_{1-x-y}Si_ySn_x$ Alloy Quantum Dots

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Background: Group IV semiconductor quantum dots (QDs) have garnered significant interest owing to their unique size and composition tunability, controlled absorption and emission (UV - near IR) optical properties. Their solution processibility, low to non-toxicity, high elemental abundance and (bio)compatibility make them promising materials for applications in optoelectronic, energy-related devices and nanomedicine.

Method & Results: Herein, the synthesis, structural and optical studies of ternary IV $Ge_{1-x-y}Si_ySn_x$ QDs are presented. Quantum confinement and Si/Sn alloying were leveraged to produce direct-gap QD alloys. Our facile colloidal strategy produces QDs with variable %Si composition (3.0-25.2%) and Sn content maintained at 4.38-5.89%. Notable size confinement and effective control is achieved across the as-synthesized QD alloys within 4.0±0.4 nm – 5.2±0.6 nm. Structural analyses reveal the expanded diamond cubic Ge crystal structure from XRD patterns with evident Scherer broadening; redshifted Ge-Ge and increasing Ge-Si Raman peaks with increasing Si; TEM analysis shows quasi-spherical and narrowly dispersed QDs without particle aggregation. Surface analyses via XPS, FTIR and TGA indicate the presence of $Ge^0/Si^0/Sn^0$ core species and $Ge^{n+}/Si^{n+}/Sn^{n+}$ charged species, indicating successful ligand passivation and stability of QDs. Energy gap values blue-shift with increase in Si composition from 1.15 – 2.33 eV for 2.99 ≤ y ≤ 25.2 eV marking a significant improvement from energy gaps obtained for the binary GeSn or single-element Ge counterparts.

Conclusion: This study achieves a systematic technique for tailoring quantum-confined $Ge_{1-x-y}Si_ySn_x$ alloys by employing control in reaction conditions. Our achievements present an exciting avenue for the development of the next generation technological devices.

Multiplexed Sensing of Electrolytes in Droplet Microfluidics

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Background: Continuous monitoring of electrolytes is crucial for managing critically ill patients. Previous intravascular sensors have faced challenges, particularly sensor biofouling in non anticoagulated blood.

Methods: We developed a fluorescence-based multiplexed ion sensing platform using droplet microfluidics. The platform utilizes preloaded oil segments containing a pH-sensitive chromoionophore, a cation exchanger, and an ionophore. By forming repeating arrays of sensor droplets, the system enables multianalyte detection of key electrolytes (e.g., K^+, Na^+, Ca^{2+}). A mini catheter introduces blood to a T-junction microfluidic chip, with flow rates of 1-3 µL/min controlled by syringe or pressure pumps.

Results: The platform achieves selective and rapid fluorescence-based detection of physiologically relevant electrolytes in whole blood. The single-use sensors mitigate biofouling, ensuring reliable, continuous measurements. Depending on flow rates and sensor segment lengths, analytes are measured every 0.5 to 3 minutes. The low blood consumption of a few mL per day makes this approach more practical compared to conventional intermittent blood draws.

Conclusions: This droplet microfluidic platform offers a reliable, high-throughput, and biofouling resistant solution for continuous electrolyte monitoring. Its minimal blood sample requirement and real-time detection capabilities provide a significant advancement over current monitoring methods.

An Electrochemical Study of a Dopant-Induced Hexagonal to Orthorhombic Phase Transition in $Fe_{2-x}Mo_xP$ Nanorods

Jordon S. Baker, Danyang Wang, Kawsar M. Alam, Indika U. Arachchige

Background. The growing dependence upon fossil fuels has caused us to look for other sources of energy that are much cleaner and more sustainable. Electrochemical water splitting represents a sustainable method for producing molecular hydrogen, a promising clean energy alternative to fossil fuels. Iron phosphides have emerged as earth-abundant catalysts for the hydrogen evolution reaction (HER), where performance can be enhanced by admixing synergetic metals to produce bimetallic catalysts. A theoretical and experimental study was conducted that reveals the influence of a dopant-induced hexagonal to orthorhombic phase transition on the catalytic activity and stability of Fe_2P nanorods (NRs) for HER.

Results. Mo was identified as the most promising dopant owing to its optimum hydrogen binding free energy (ΔG_H) on a Fe_2P (210) surface. Hexagonal and orthorhombic $Fe_{2-x}Mo_xP$ NRs ($x = 0 – 14\%$) were colloidally synthesized to investigate the structure- and composition-dependent HER activity. Upon incorporation of Mo, the underlying hexagonal Fe_2P phase transformed into orthorhombic $Fe_{2-x}Mo_xP$ when $x \geq 0.11$ (5.41%). The HER performance was observed to be both phase- and composition-dependent with orthorhombic $Fe_{2-x}Mo_xP$ NRs ($x = 0.09$) exhibiting a superior activity and overpotential of 222 mV at a current density (j) of -10 mA/cm^2 compared to hexagonal Fe_2P and mixed-phase $Fe_{2-x}Mo_xP$ ($x = 0.11 – 0.28$) catalysts. Although all compositions displayed a Volmer-Heyrovsky HER mechanism, the admixture of Mo improved the HER kinetics, producing the lowest Tafel slope (167.08 mV/dec) for orthorhombic $Fe_{1.91}Mo_{0.09}P$ NRs.

Conclusion. The highest HER performance was achieved for orthorhombic $Fe_{1.91}Mo_{0.09}P$ NRs with a dopant composition of 4.58%. The incorporation of Mo improves the charge transfer resistance and preserves the stability of hexagonal and orthorhombic NRs in alkali medium. This study advances the understanding of dopant-induced crystal structure transitions and paves the way for efficient and stable catalytic material design.

Methods. Powder X-ray Diffraction (PXRD), Transmission Electron Microscopy (TEM), Energy-Dispersive X-ray Spectroscopy (EDX), Scanning Transmission Electron Microscopy (STEM), X-ray Photoelectron Spectroscopy (XPS), Linear Sweep Voltammetry (LSV), Cyclic Voltammetry (CV), and Chronopotentiometry (CP).

Bugs in the Flux: Characterizing the cascading effects of forest disturbance & composition on arthropod communities & heterotrophic respiration

Erin-Darby McClain[1], Justine Crochetière[2], Jean-Philippe Lessard[2], Christopher Gough[1]

Background: Global increases in the extent and frequency of biotic disturbances pose significant threats to forested ecosystems and their services, including carbon sequestration and storage. Half of carbon losses from temperate forests are attributed to soil respiration (Rs), a dynamic carbon flux sensitive to disturbance. Disturbance-driven changes to forested ecosystems lead to small-scale changes in Rs, which have the capacity to change forests from carbon sinks to sources. Rs sources are primarily attributed to heterotrophic microbes and roots, however, arthropods are largely overlooked sources of heterotrophic respiration presenting a significant knowledge gap and potential underestimations of Rs. Thus, understanding responses of arthropod communities to forest disturbance can shape our understanding of ecosystem functions. This study investigates cascading effects forest disturbances can have on arthropod communities and Rs using a manipulative forest disturbance experiment in Northern Michigan.

Methods: Each of four landscape types (replicates distinguished by soils and community composition) were subjected to four different disturbance-severity treatments: 0%, 45%, 65%, and 85% canopy removal via girdling, yielding four plots across each landscape type. Each plot was further subdivided into two sub-plots. Five pitfall traps were deployed in each sub-plot across two sampling periods and arthropods were counted and identified. Heterotrophic respiration was measured as efflux using a portable infrared gas analyzer.

Results and Conclusions: Preliminary analyses suggest pre-disturbance site productivity and landscape type is more influential than high disturbance severity in predicting cascading changes in canopy structure, microclimate, and arthropod communities. There is no direct link between arthropod communities and Rs.

Body Composition Determinants of NTproBNP in Patients with Obesity and HFpEF

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Introduction: In heart failure with preserved ejection fraction (HFpEF), patients with obesity are characterized by lower NTproBNP compared to their leaner counterparts. The role of other body composition compartments has been largely unexplored. We want to investigate the effect of body composition on NTproBNP level in patients with obesity and HFpEF.

Methods: In this cross-sectional analysis, we used: 1) BIA analysis to measure fat mass(FMI, kg/m^2) and lean-mass-index(LMI, kg/m^2); and 2) BIS to measure total body water(TBW, %), intracellular water(ICW, %), extracellular water(ECW, %), and edema index[EDI] (ECW/TBW, %). We used Spearman's test to examine correlations between body composition and NTproBNP, and linear regression methods to assess the individual contribution. We used the Mann-Whitney-U test to compare groups above and below the median NTproBNP value.

Results: In 95 patients: 1) 78% female; 2) 64(54-70) years of age; 3) BMI of 37.3(32.9-40.8) kg/m^2; and 4) NTproBNP of 91(50-225) pg/mL. NTproBNP was associated with BMI($r=-0.40$, $p<0.001$), FMI($r=-0.37$, $p<0.001$), and LMI($r=-0.212$, $p=0.04$). With regards to body water, NTproBNP was associated with ECW%($r=0.30$, $p=0.004$), but not with TBW% nor ICW%. NTproBNP was also positively associated with the EDI($r=0.50$, $p<0.001$), which was in-turn, negatively associated with FMI($r=-0.30$, $p=0.003$). In linear regression, EDI was the only independent predictor for NTproBNP($\beta=0.51$, $p<0.001$). Finally, patients with NTproBNP levels below the median value (91 pg/mL) presented a lower EDI(42.4% vs 44.1%, $p<0.001$) (**Figure 1**).

Conclusion: Study demonstrated that in patients with obesity and HFpEF the EDI is the strongest predictor for NTproBNP levels, independent of measures of adiposity (FMI).

Consumption and Crow: Tuberculosis in Early 20th Century Virginia

Elizabeth Dooley

Department of History

Background: Tuberculosis (TB) was widespread in the first half of the 20th century, and Virginians were not exempt from disease transmission. As mobile x-ray clinics, pneumothorax stations, and sanatoriums were becoming commonplace throughout the commonwealth, segregation laws throughout Virginia made an impact on treatment. This research project is examining at the disparities in treatment options across race and socioeconomic status in Virginia prior to 1960.

Methods: Both quantitative and qualitative methodology will be used while analyzing primary and secondary sources, including reports, census records, and other articles. Case studies from other southern and mid-Atlantic states will be used for comparative purposes.

Results: Despite the number of beds available in segregated hospitals throughout Virginia seemingly reflecting the population at the time, available data supports the disproportionate availability of and access to care based on race. In urban locations, living conditions and employment also played a factor into the contraction and spreading of TB.

Conclusion: The goal of this project is to bring awareness to this under-researched topic in Virginia's history and highlight the disparities in healthcare in the first half of the 20th century. Further research will be done to showcase the importance of public health nursing in Virginia communities, especially those with vulnerable populations.

Racial Identity, Parenting, and Parenting Stress in Black Mothers of Children with Attention-Deficit/Hyperactivity Disorder

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Virginia Commonwealth University

Background: Despite an abundance of research on families of children with attention-deficit/hyperactivity disorder (ADHD), there is a dearth of research on Black families (Merrill et al., in press). In a deficit-focused field, there is a need to identify variables related to positive outcomes within the Black community. This pilot study aimed to examine how racial identity (RI) may relate to parenting stress and parenting in Black mothers of children with ADHD.

Methods: Participants were 41 Black mothers (M_{age} = 35.39, SD_{age} = 6.49) of children with ADHD (43.9% female; M_{age} = 7.73, SD_{age} = 1.38) living in the southeastern United States. Mothers and children attended a study visit to complete the Alabama Parenting Questionnaire (Frick, 1991), Parenting Stress Index-Short Form (Abidin, 1995), and Multidimensional Inventory of Black Identity (MIBI; Sellers et al., 1998).

Results: Pearson's correlations were used to investigate the relationships between RI, parenting, and parenting stress. A humanist RI was negatively associated with parental involvement (r = -.330, p = .037). Centering Blackness was negatively related to poor monitoring (r = -.453, p = .004). Finally, feeling positively toward Black people was negatively correlated with stress related to parent-child dysfunctional interactions (r = -.341, p = .032).

Conclusions: Results suggest that a strong Black RI may relate to more desirable parenting outcomes in Black families of children with ADHD. Results also suggest that RIs, such as private

regard, should be further investigated as a potential protective factor against some of the negative relational impairments associated with ADHD.

Black parents' and children's Africultural and Mainstream Coping strategies across self-report and observational data sources

Nilee T. Kerr, B.S. & Fantasy T. Lozada, Ph.D.

Background: Research has shown that racism-related stress can lead to symptoms of anxiety, depression, lower self-esteem, and other health issues. Studies on coping behaviors in Black communities identify Africultural coping strategies as culturally relevant responses to stress, including spirituality, communalism, humor, and creative emotional expression (Gaylord-Harden et al., 2009). In contrast, mainstream coping strategies—based on a European worldview—include active coping, avoidance, distraction, and advice-seeking (Utsey et al., 2000). Most research on African American coping emphasizes mainstream strategies, but there is growing interest in a more Africultural affective science (Lozada, 2024) that integrates both Africultural and mainstream approaches.

Methods: In response to this need, we examined mixed method data from nine Black families of middle schoolers from a pilot study on emotion regulation and coping. To explore parents' Africultural and mainstream coping strategies, we analyzed responses to questionnaire items on managing stress (e.g., "When you feel stressed, how do you let your feelings out?"). We also examined interview responses and parent-child discussions on coping with racial experiences. Parents' and youths' coping strategies were coded as Africultural, mainstream, or other (average agreement = 97%).

Results and Conclusions: Our analysis showed that most parents preferred Africultural strategies, while only one youth showed a similar preference. Black youth exhibited diverse coping preferences, with some favoring mainstream strategies and others using a blend of coping methods. This study offers an initial framework and codebook for classifying African American coping strategies, helping researchers and practitioners develop a more culturally relevant understanding of stress and coping within African American communities.

Practical parameter identifiability of respiratory mechanics in the extremely preterm infant

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Background: The complexity of mathematical models describing respiratory mechanics has grown in recent years, however, parameter identifiability of such models has only been studied

in the last decade in the context of observable data. This study investigates practical parameter identifiability of a nonlinear respiratory mechanics model tuned to the physiology of an extremely preterm infant.

Methods: The model predicts airflow and dynamic pulmonary pressures and volumes under varying levels of continuous positive airway pressure with a range of parameters characterizing surfactant-treated and deficient lung health scenarios. This study implements the Morris screening method to measure global influence against scalar clinical measurements associated with airflow and pleural pressure waveforms. Non-influential parameters remained fixed at baseline estimates, and the model was reduced by linearizing non-influential constitutive relations. Local, gradient-based sensitivity analysis was applied to rank parameters against airflow and pleural pressure signals, and singular value decomposition-based subset selection was used to obtain a sensitive, identifiable parameter set for optimization against clinical data.

Results: Nominal model outputs for surfactant-treated and deficient lung scenarios produced physiologically relevant outcomes, with suppressed airflow and tidal volumes observed in the deficient case. Sensitivity analyses identified 11 influential parameters over all continuous positive airway pressure levels and lung health scenarios. Gradient-based optimization against a clinically extracted data set resulted in a patient-specific parameter set well within physiological constraints.

Conclusion: This study demonstrated the potential for using practical parameter identifiability techniques to expose underlying mechanisms of impaired respiration, which could lead to improved clinical prevention and intervention strategies.

Droplet microfluidics-based optical sensing platform for glucose monitoring in blood

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Background: Patients in ICUs often develop metabolic disturbances such as sepsis-induced hypermetabolic stress, leading to altered carbohydrate metabolism, hyperglycemia, and insulin resistance. Regular glucose monitoring is crucial for maintaining tight glycemic control, especially in cases of uncontrolled hypo- or hyperglycemia.

Methods: To address this, we aim to develop a biphasic continuous glucose monitoring (CGM) system by optimizing a fluorimetric enzymatic assay through two approaches:

i. Enzymatic Fluorescence Detection: Glucose oxidase catalyzes glucose oxidation to gluconolactone, reducing oxygen to hydrogen peroxide. In the presence of HRP enzyme, H_2O_2 oxidizes Amplex Red to form the fluorescent resorufin.
ii. PET-Based Sensing: A diboronic acid-based PET sensor with a 9,10-bis-(aminomethyl) anthracene core selectively binds glucose through inward-facing

boronic acid moieties. Glucose binding restricts molecular flexibility via boron-nitrogen bond formation, suppressing the PET effect and enhancing fluorescence.

We propose that resorufin can be extracted from minimal blood volumes into the oil phase using the anion exchanger TDMAC, while the glucose-sensing probe in the oil phase would transfer into the aqueous phase due to its strong glucose affinity. A droplet microfluidics platform enables precise low-volume chemical diagnostics by generating uniform droplets of oil and blood on a PDMS chip where the fluorescence of the oil is measured at the end of the channel.

Results: We were able to see a concentration-dependent fluorescence change with increasing glucose concentrations.

Conclusions: This high-throughput approach is expected to facilitate whole-blood glucose analysis while minimizing optical interference from the sample.

Shell-Shocker: A Case for the De-extinction of *Doedicurus clavicaudatus*

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Background: As ecosystems face widespread degradation, the resilience of remaining species may not suffice to restore ecological balance. With scientific advancement increasing the plausibility of de-extinction, which is bringing extinct species back to life. Animals like the Thylacine, Passenger Pigeon, and Woolly Mammoth are candidates for de-extinction, with surprising amounts of progress in each. However, some ecologically valuable species, which went extinct at the same time as other candidates (or sooner), have been largely overlooked. One example is *Doedicurus clavicaudatus*, a large herbivorous armadillo that was a dominant grazer in the Pampas grasslands of Argentina.

Methods: We performed a literature review to explore the feasibility of reintroducing *Doedicurus* to its former habitat. Using current knowledge of the Woolly Mammoth as a comparative reference, we explore the anthropogenic, genetic, and ecological challenges of de-extinction in *D. clavicaudatus*.

Results: We infer that key considerations include potential for conflict with humans, genetic viability, and ecosystem engineering capacity. Our analysis supports the inclusion of *Doedicurus* as an additional candidate for de-extinction.

Conclusions: By exploring environmental modeling and genetic data from scientific literature, we conclude that the reintroduction of *Doedicurus* in the Argentinian pampas can restore ecological balance, and that megafauna can potentially remediate climate change.

Expression Analysis of Floral Symmetry Candidate Genes in *Browallia speciosa*

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Background: Stamen structure is one of the deciding factors for an angiosperm's pollination syndrome. The Solanaceae hold particular interest in understanding pollination due to their development of bilateral symmetry (zygomorphy), and visitation by a variety of pollinators. Previous studies reveal that symmetries of the Solanaceae are not solely determined by *CYC2-like* genes, particularly regarding the zygomorphic corolla. This is unusual, as *CYC2-like* genes and other *TCP* transcription factors have been found to control the floral symmetry in a majority of studied angiosperms. *Browallia speciosa* is a particularly interesting organism due to its three different types of stamens, which aid a unique pollination process.

Methods: This project investigates the molecular basis for the development of floral organs and bilateral symmetry in *B. speciosa*. To achieve this, RNA-seq data was analyzed to explore differential gene expression across 5 different floral organs in *B. speciosa*, and identify candidate genes that are responsible for its symmetry and organ development.

Results: *B. speciosa's de novo* transcriptome reveals differential expression of *TCP* transcription factors, along with *ANT-like, BOP-like, JAG-like, PAN-like*, and *RBE-like* genes. In addition, gene ontology enrichment analyses highlight lipid metabolism pathways as promising novel avenues for understanding floral symmetry and reproduction.

Conclusions: In the future, these results may serve as the basis for functional studies to confirm the function and downstream effects of mutations in these significant genes. As the molecular comprehension of floral symmetry and pollination expands, we can make more informed decisions regarding the stewardship of consequential crops and medicinal plants.

The Effects of Nicotine Salts on Arterial Hemodynamics and Stiffness in Young Regular Users of E-cigarettes

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Introduction: E-cigarettes deliver nicotine salts, which are absorbed more rapidly than freebase nicotine in combustible tobacco. While freebase nicotine is linked to changes in arterial health, the effects of nicotine salts remain unclear. This study investigates the impact of nicotine salts on arterial hemodynamics and stiffness in regular e-cigarette users.

Methods: Fourteen young healthy, regular users of e-cigarettes participated in the study with an initial and a follow-up visit fourteen days after being randomized to either e-cigarettes with or without nicotine salts. Cotinine was evaluated to monitor the use. Arterial hemodynamics and stiffness were assessed via applied tonometry to evaluate systolic (SBP), diastolic (DBP), mean arterial (MAP) blood pressure, and pulse-wave velocity (PWV).

Results: A significant difference in cotinine was identified between those who maintained or increased (+C, n=7; Δ=+30±30 ng/mL) and those who decreased (-C, n=7; Δ=-173±115 ng/mL) use of e-cigarettes with nicotine salts. A significant decrease in arterial stiffness (ΔPWV=-0.59 m/s, p=0.045) was observed in the -C group while no changes in blood pressure were observed between the groups. Positive associations between the changes in cotinine and changes in hemodynamics including SBP, DBP, and MAP were observed ($r \geq 0.627$; $p \leq 0.016$). A change in arterial stiffness was associated with a change in SBP, but not DBP or MAP.

Conclusions: Reductions in nicotine-salt exposure from e-cigarettes were associated with reduced arterial stiffness in regular users, inferring that nicotine salts might contribute to adverse arterial changes. Further studies are needed to assess the long-term effects of nicotine salts on arterial health.

College of Health Professions

Enhancing Patient Satisfaction: The Role of Cultural Competency Leadership and Training in U.S. Hospitals

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Health Services Organization and Research

Background: Cultural competency training for healthcare providers is critical in equipping providers with the skills and knowledge to provide culturally competent care, thereby increasing patient satisfaction. This research expands the geographical scope of previous studies to gain a deeper understanding of the prevalence and impact of cultural competency practices on patient experience on a national level.

This study examines the relationship between cultural competency leadership and training (CCLT) practices and patient perceptions of care quality in acute care hospitals across the United States.

Methods: The study focuses on four strategic practices of CCLT: (1) setting goals to improve the quality of care for diverse patient populations, (2) creating a diversity plan, (3) providing cultural competency training during new-hire orientation, and (4) requiring diversity training. Using the AHA and HCAHPS datasets, the study utilizes propensity score matching and logistic regression analysis to estimate the effect of CCLT (IV) on patient satisfaction (DV) while accounting for potential observable confounding variables to reduce bias.

Results: The study found that CCLT is significantly associated with top-box hospital overall rating (β=1.593; $p<0.05$), nurse communication rating (β=1.321; $p<0.01$), and doctor communication rating (β=0.791; $p<0.05$). However, this study did not find evidence supporting the association between CCLT and the likelihood of recommending hospitals.

Conclusions: The findings suggest the important role of cultural competency in improving patient satisfaction, notably patient-provider communication. Hospitals should implement more cultural competency practices to provide better care experience for patients.

Attentional Demand of Upper Limb Prostheses and Its Relationship with Embodiment

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Purpose/Hypothesis: Despite providing function and cosmetic appearance, all upper limb (UL) prostheses have shortcomings in providing the full sensorimotor utility of the intact limb. As a result, prosthesis users often report increased attentional requirements, which can lead device rejection. Embodiment, a feeling of device control and integration with the body, is a commonly used research metric in qualifying prosthesis acceptance, an important contributor to long-term prosthesis use. While prosthetic attentional demand and embodiment have been identified as important factors, the relationship between them remains unexplored. This study aimed to elucidate the interplay of prosthetic embodiment and attentional demand from the perspective of UL prosthesis users.

Number of Subjects: Participants (n = 25) with unilateral or bilateral UL loss at or above the wrist attended virtual focus groups. All participants reported body-powered, myoelectric and/or passive UL prosthesis usage of 6 months or longer.

Materials and Methods: Focus group transcripts were compiled, and two researchers independently excerpted and coded each participant. Codes were reconciled through discussion

with a third researcher. Co-occurring codes for amount of attention and prosthetic embodiment were then identified and reviewed to explore the relationships between these factors.

Results: Increased attention was reported with frustration due to lack of control over the prosthesis *(e.g., "There are definitely times when you get frustrated…when it doesn't let go and you want it to let go, it lets go when you don't want it to let go." [FG3_19]*). This finding reflects an overall trend of increased attention and a lack of integration with the prosthesis, sometimes leading to device disuse (*e.g., "…either the fit's not working or I'm having trouble controlling it…I will just take it off and finish whatever I was doing" [FG4_24*). Decreased attentional demand codes co-occurred with feelings of embodiment with the prosthesis *(*e.g., *"The more you get used to [the prosthesis], the less you think about it because it becomes a part of you" [FG4_23]*). Embodiment codes were associated with feeling control over the prosthesis, expressed as task automaticity (*e.g.,* "*…if you don't pay attention to it, it just feels like it's a part of you…there's a lot of times I don't think about things that I'm trying to do…*" [FG2_09]).

Conclusions: Increased attentional demand while using a prosthesis was correlated with feelings of lack of control and device disuse, a trend that is reflected by current research.[4,7] Attentional demands increased in situations where the user felt unable to control the prosthesis and that it was not fully integrated with them. Conversely, low levels of attention were correlated with device integration as expressed by embodiment. These findings suggest that prosthetic attention could be an important driver of embodiment.

Clinical Relevance: Clinical practice could benefit from a metric quantifying prosthesis attention to inform training strategies in maximizing device embodiment.

School of Social Work

Improving Estimation of Service Utilization and Needs Among People with Serious Mental Illness in the National Survey on Drug Use and Health: A Person-Centered Approach

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Background: Local, state, and federal policymakers plan the scope and extent of public mental health services using National Survey on Drug Use and Health (NSDUH) serious mental illness (SMI) estimates. The Substance Abuse and Mental Health Services Administration is statutory obligated to provide SMI prevalence estimates, but the current NSDUH algorithm conflates suicidality with SMI which fails to differentiate ongoing, long-term support needs from short-term mental health crises. Additionally, it does not assess disability severity or symptom duration. We

hypothesize service utilization and disability level will be more accurately identified by a latent profile analysis (LPA) approach than the current NSDUH algorithm.

Methods: Analyses included all 2022 NSDUH adult respondents (n = 47,100). The best fitting LPA model of mental illness severity was determined using the Bolck-Croon-Hagenaars three step method for LPA with covariates and distal outcomes. Receiver operating curve analyses were then used to compare how accurately the LPA and NSDUH SMI algorithm identified respondent service utilization and disability level.

Results: The LPA best estimated service utilization ($p < 0.0001$) and disability severity ($p < 0.0001$) with greater specificity, positive predictive value, and lower total classification error.

Conclusions: The LPA more accurately predicted participant service utilization, disability severity, and symptom duration. Utilization of an LPA model could facilitate more appropriate mental health services planning for people with SMI who benefit from ongoing, long-term mental health services. Policymakers and researchers should consider the benefits of a more nuanced and person-centered approach when estimating SMI at the population level.

Suicide Risk in College Students: Exploring Alcohol Use and Belonging with a Multinomial Growth Model

Samuel Ochinang

Background: Suicide rates are disproportionately high among young adults aged 18–25. Although alcohol use is linked to suicidality in college students, protective factors remain unclear. Contemporary suicide theories frame suicidality as fluid and highlight belongingness as a key buffer, supporting the need for longitudinal research. This study examines predictors of suicidality over time and tests whether belongingness moderates the impact of alcohol use on suicide risk.

Methods: Data were drawn from *Spit for Science*, a longitudinal study at a large public university. The analytic sample included 359 students who completed three survey waves between 2021 and 2024. Suicidality was categorized as no suicidality, ideation only, or suicide attempt. Alcohol use was measured by binge drinking frequency and drinking to cope. Multilevel modeling estimated transitions in suicidality over time, with belongingness tested as a moderator and depressive symptoms, age, sex, and race/ethnicity included as covariates.

Results: Suicidality varied significantly over time, with higher ideation and attempts in Wave 1 and a shift toward no suicidality in Waves 2 and 3 ($\chi^2(4) = 84.56$, $p < .001$). Compared to no suicidality, greater drinking to cope predicted increased odds for ideation (OR = 1.73) and attempts (OR = 2.41), and depressive symptoms predicted ideation (OR = 1.28). No significant interaction effects with belongingness were found.

Conclusion: This study highlights the fluid nature of suicidality. Interventions that address alcohol use, particularly in the context of mitigating depressive symptoms, may help reduce suicide risk.

Understanding Intimate Partner Violence Typology Experience in Temporary Assistance for Needy Families (TANF) Recipients

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Background: Intimate partner violence (IPV) manifests in distinct typologies: physical violence, sexual violence, emotional aggression, and coercive tactics (Breiding et al., 2015). Extant research shows that women receiving cash assistance through the Temporary Assistance for Needy Families (TANF) program experience higher rates of intimate partner violence than women in other socioeconomic brackets (Leone et al., 2004; Spencer et al., 2022), but less is understood about the typology of violence perpetrated on women receiving TANF benefits. By analyzing specific characteristics of intimate partner violence, this research will seek to answer the question of whether there is a statistically significant difference in typology experience by TANF recipients.

Methods: This cross-sectional survey design uses publicly available secondary data from Year 9 of the Future of Families and Child Wellbeing Study. This study uses purposive sampling to include all mothers who completed the Year 9 interview (n=3515). Year 9 data was collected between 2007-2009. Data was analyzed using descriptive statistics, crosstabulation, and independent samples t-tests.

Results: Preliminary results show no statistically significant difference in overall experience of intimate partner violence between TANF recipients and non-TANF recipients. Further statistical analysis identified the relationship between TANF receipt and specific IPV typologies.

Conclusions: A better understanding of how intimate partner violence manifests in this population may enable practitioners to create screening tools and interventions specifically for TANF recipients, potentially leading to an overall reduction in intimate partner violence across this population.

Prevalence of non-Communicable Diseases and Behavioral Risks Among Older Adults in Mongolia

Zoljargalan Gantumur, Yifan Lou

Background: Non-communicable diseases (NCDs) pose significant health burdens in Mongolia, a lower-middle-income country in Central Asia, where 16% of the population is projected to be retirement age by 2045. NCDs are the leading causes of morbidity, mortality, and disability in later life, yet NCD-related research in Mongolia remains limited. Using nationally representative data, we investigated the prevalence and behavioral risk predictors among older Mongolians.

Methods: Data were from 1,989 participants in Mongolia's National NCD Risk Factor Surveillance Survey (2019). NCDs were measured by the diagnosis of hypertension, raised

cholesterol, cardiovascular diseases, and diabetes. We also consider numbers of NCDs (0, 1, 2+) for potential nonlinear relationships. Logistic and multinomial logistic regression were used to understand sociodemographic and behavioral risk factors (frequency of fruit, vegetable, and salt consumption and moderate-intensity exercise) of NCDs.

Results: 64% of sampled older Mongolians had an NCD, with hypertension being the most prevalent. 24.1% had 2+ NCDs, and females were more likely to have 2+ NCDs. Behavioral risk factors were only significant in predicting cardiovascular diseases. Socio-demographic predictors for each NCD vary, with low socioeconomic status (SES), including being unemployed, lower income, and urban residency, being the strongest predictors for NCDs, even after controlling for behavioral risks.

Conclusions: SES matters more than behavioral factors for NCDs among older Mongolians, highlighting the need for targeted health promotion programs to address these risk factors.

Examining Life Satisfaction and Depression Among Biracial Black-White Emerging Adults

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Background: Biracial Black-White youth navigate complex structures, systems, and unique challenges that can influence their overall well-being, contributing to disparities in their mental health. This construct is operationalized in this study as life satisfaction and depression. A substantial body of literature explores the experiences of biracial individuals with white mothers and Black fathers. However, the nuances and unique dynamics associated with having a white father and Black mother remain understudied.

Methods: The sample size comprised of 411 Biracial Black-White emerging adults (52.8% Cisgender Women, 53% Cisgender Men, 2.2% Transgender Men, and 0.5% Non-Binary) examining whether the race/gender combination of their parents (white mom/Black dad vs. white dad/Black mom) is associated with differences in these outcomes through independent sample t-tests.

Results: Participants with white mothers/Black fathers reported a mean life satisfaction score of 4.90 on a 7-point scale (SD=0.98, N=224), whereas those with a white father/Black mother had a mean score of 4.84 (SD= 0.82, N=187). The mean score of depressive symptoms of Biracial Black-White youth with a white mother is 2.28 on a 4-point scale (SD= 0.65), whereas those with a white father is 2.40 (SD= 0.53). Both groups report relatively neutral life satisfaction, with only a small mean difference suggesting no substantial distinction (t =0.63, df=409, p=0.53). Both groups report low levels of depressive symptoms with no statistically significant differences (t =-1.99, df=409, p=0.42).

Conclusion: While no statistically significant differences emerged, participants with white fathers and Black mothers reported less optimal levels of satisfaction with life and depressive symptoms.

Poetic Transcription as a Qualitative Method for Understanding Strategies for Violence Prevention Among College Students At Risk for Sexual Violence

Rose E. Miola, Adrienne Baldwin-White

Background: Sexual violence in university students is a national public health issue with far reaching, long term effects on survivors' mental health. Research has shown that people of color, women, and queer students are most vulnerable to experiencing sexual violence. This study considered 1) how people of color, women, and queer students understand sexual violence in their communities, and 2) what they want to change in order to prevent and respond to this violence in a better way.

Methods: Qualitative data was collected from a larger convergent parallel mixed methods study about gender-based violence. Students were recruited through email blasts, university news, and university student organization partnerships (N=63). Qualitative data was collected through structured interviews in a virtual chat. Responses were coded through thematic analysis and poetic transcription to create found poems.

Results: Poems highlighted emergent themes according to identity. Queer, trans, and nonbinary students discussed cultural and societal misunderstandings about their community, and not being included in popular conceptions of gender-based violence. Women spoke about not being believed when reporting experiences of sexual violence. Asian, Latine, and Black students expressed a need for more specific resources catered to their cultural identities and more discussion about sexual violence in their communities.

Conclusions: Universities should create culturally responsive prevention approaches that better serve students with marginalized identities, particularly students of color and queer students. University school wide education efforts should include education about LGBTQ+ experiences of sexualization and violence, and believing women when they speak about sexual violence.

Does trauma type matter when evaluating adult suicide risk level?

Lisa Borntrager

Background: Over 49,000 adults died by suicide in the United States in 2022 (Centers for Disease Control and Prevention [CDC], 2023), making suicide the second leading cause of death for Americans under 45 years of age (CDC, 2024). Psychological autopsies have shown that around 40% of those that died by suicide had a history of trauma (McMahon et al., 2022), with community studies of attempts showing as high as 78% (Sachs-Ericsson et al., 2017). Shneidman's theory of suicide (1993) draws attention to the relationship between psychache and suicide. Psychache refers to an extreme psychological pain characterized by intense negative judgements of oneself and has been found to be predictive of suicidality over multiple studies (Ducasse et al., 2018; Meerwijk & Weiss, 2014; Tossani, 2013). Some types of trauma, such as adverse childhood events, have been shown to mediate the relationship between psychache and suicide, showing the need to explore how different types of trauma impact suicidality (Bendit, 2011; Ihme et al., 2023). While trauma

is a known risk factor for suicide, only a limited number of studies have explored how different types of trauma, such as sexual assault, affect suicidality (Belik et al., 2007: LeBouthillier et al., 2015).

Methods: A logistic regression was employed to examine the association between different forms of trauma and suicide risk level.

Results: Results show that certain types of trauma are significant predictors of suicide risk level.
Conclusion: This study has implications for how trauma types may be conceptualized in suicide risk assessments and treatment.

L. Douglas Wilder School of Government and Public Affairs

"America's Scapegoat: Transgender People"

Casey Renée Lopez

Public Policy and Administration

Background: Public policies often categorize citizens into target groups based on social constructions and perceived political power, impacting access to essential services. Transgender people, a growing minority in the U.S., have become a focal point in political discourse, facing discriminatory policies that affect not only their social mobility, but their access to healthcare, housing, and employment.

Methods: My analysis uses the social construction of target populations framework to examine how transgender people are classified and treated within the policy landscape. This framework enables exploration of the various roles that moral entrepreneurs, moral panics, and degenerative policy designs play in the marginalization of transgender people from the individual level to the community level.

Results: The literature indicates that transgender people are frequently constructed as a "deviant" target group, leading to policies that limit their rights and opportunities for fulfilling lives.

Negative categorization is perpetuated by political actors who rely on fearmongering and scapegoating to advance discriminatory legislation at all levels of government.
Conclusions: It is essential to shift social perceptions of transgender people and promote equitable policy design to counter the harmful impacts of degenerative policies. Such shifts can be achieved through increased representation, sensitivity training, and proactive measures by public servants, educators, and researchers to advocate for and implement inclusive policies regarding gender-expansive people.

Corruption and Foreign Direct Investment: Empirical Assessment of the Mediating Role of Institutional Quality and Political Stability in Ghana

Isaac Yeboah

Public Policy and Administration

Background: Foreign Direct Investment (FDI) provides more than just capital; it introduces technology and managerial expertise, which contribute significantly to economic growth. However, corruption, measured by the Corruption Perceptions Index (CPI), deters inflows. This study examines how Ghana's CPI relates to FDI, with institutional quality and political stability as mediators accounting for GDP, inflation, and exchange rates as covariates.

Methods: Using a non-experimental quantitative design, this study analyzes annual data from 1995–2022. CPI data are sourced from Transparency International, FDI from the IMF, and institutional quality and political stability from the Worldwide Governance Indicators. Covariates (GDP, inflation, real exchange rate) are sourced from the World Bank. The study employed the PROCESS Procedure by Andrew F. Hayes mediation analysis to estimate the coefficient of the total, direct, and indirect relationship between CPI and FDI, testing hypotheses via Scott's Institutional Theory and International Political Economy frameworks. Assumptions of linearity, normality, and homoscedasticity were verified.

Results: Improvements in CPI significantly increase FDI inflows (total effect: coeff = .4920, p = .0059), whereas institutional quality strongly mediates this relationship (indirect effect: .1691, significant), enhancing FDI by fostering a stable investment climate. While GDP positively influences FDI, Political stability's mediating role is minimal (indirect effect: .0155, insignificant).

Conclusions: Addressing corruption boosts FDI in Ghana, with institutional quality as a key mediator over political stability. Policymakers should prioritize institutional reforms and macroeconomic stability to attract investment. Future research should explore qualitative dimensions and comparative analyses to deepen understanding.

ACWUS: Artificially Constructed Wetlands for Urban Sewage Treatment

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Background: In Delhi, India, stormwater drains carry runoff and un/partially treated sewage into river Yamuna. Ongoing projects/plans to remediate them ignore WaSH (Water Sanitation Hygiene) needs of ~1.5 million residents of informal settlements (JJCs). This is a public health crisis *and* environmental crisis. Despite investment by local, national, and international actors in the WaSH sector, access is fragmented by the tumultuous social, political, and legal histories of "slum" eviction and infrastructure/service provision issues.

Methods: This study aims to answer both the *where* and the *how* of implementing coordinated WaSH-drain remediation projects by mapping the network of actors providing services in JJCs, their tasks for each service, existing relationships with each other, and the instruments dictating these actions. Information for network mapping was sourced through a content analysis of 63 actor websites, and ~650 documents about "slums", land-use, drainage, sewerage, water management, waste management, sanitation, and services.

Results: Network mapping identified key actors implementing coordinated WaSH projects. Major contributors include: the Ministry of Urban Development which issues national policies and implements urban renewal schemes, and the Delhi Urban Shelter Improvement Board which manages "slums", provides toilets, and implements sanitation facilities in JJCs. Beyond single actors, network mapping revealed key relationships between actors and specific metrics of centrality and linkages.

Conclusions: This study built an interactive, open-access network map addressing coordination challenges posed by regulatory overlap in Delhi, consolidating all information required to understand a complex institutional framework into a tool to analyze the network qualitatively and quantitatively.

Social Media and Police Misconduct: Impact on Legitimacy and Cooperation with Campus Police.

Kamal Alhassan

Public Policy and Administration

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Background: In today's digital age, social media has become a key conduit for disseminating information on police misconduct. While numerous studies have explored its impact on public perceptions of municipal police, less is known about how social media portrayals of police misconduct shape student perceptions of campus police legitimacy, procedural justice, and cooperation. Drawing on cultivation theory, this study investigates the influence of exposure to and engagement with social media content of police misconduct on campus police perceptions among college students.

Methods: A cross-sectional survey was administered and completed by approximately 500 students at Virginia Commonwealth University during Fall 2024. The survey measured self-reported exposure and engagement with social media content of police misconduct, alongside indicators of campus police legitimacy, procedural justice, and willingness to cooperate with campus police. Control variables included media consumption habits, perceptions of distributive

justice, personal or vicarious negative police encounters, and key demographic characteristics. Ordinary least squares regression analyses were employed to assess the independent effects of social media exposure on student perceptions.

Results: Preliminary results indicate that viewing stories of police misconduct on the internet and social media is significantly related to lower self-reported perceptions of campus police legitimacy and procedural justice as well as cooperation with campus police. On the other hand, results indicate viewing stories of police misconduct on traditional local and national news is significantly related to higher self-reported perceptions of legitimacy and a greater likelihood of cooperating with campus police.

Conclusions: This study is expected to contribute to the literature by illuminating the role of social media in shaping campus police legitimacy. The findings may inform campus policing strategies and communication practices, with implications for enhancing trust, procedural fairness, and public safety within university settings.

From Margins to Mainstream: a geospatial analysis proposing Nature-based WaSH Solutions for Delhi's nullah-adjacent settlements

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Public Policy and Administration

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Background: In Delhi, stormwater drains carry runoff and un/partially treated sewage into river Yamuna. Ongoing projects and plans to remediate them ignore the Water, sanitation and hygiene (WaSH) needs of ~1.5 million residents of adjacent informal settlements. Unfortunately, redundancies, uncertainties, competing agendas and bureaucratic rivalries have further complicated treatment efforts.

Methods: We implement a citywide suitability analysis for drain-adjacent informal settlements to determine where NBS solutions are viable. We expand on the ALLOWS approach first pioneered by Van Afferden et al (2015) and Khurelbaatar et al. (2021). We collect the most up-to-date data on key geo-spatial, terrain and climate parameters. We combine this with government and NGO data on the locations and sizes of Delhi's informal settlements, existing public toilets and drain network.

Results: We first eliminate settlement locations that are either too far away from a drain, or where access to a drain is blocked by terrain features. We then further restrict sites based on the availability of suitable land. We then discuss a few cases at site-scale, including a hydrology analysis demonstrating these projects can withstand Delhi's legendary monsoons and avoid system overload common in Delhi's sewers.

Conclusions: This is a companion to an actor/institutional network analysis; together, they provide answers to where and how implementing coordinated WaSH-drain remediation projects can occur.

Exploring Equity and Excellence: A Mixed Methods Study of Research Funding Disparities and Success Among Women Faculty of Color at a Research-Intensive University

Mary Strawderman

Public Policy and Administration
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Background: The loss of diverse perspectives in academia represents a problem with far-reaching implications for innovation, scientific understanding, and societal advancement. This is in part due to the persistent attrition of women and faculty of color. Contributing to this problem is inequality in extramural research funding. This study investigates individual, interactional, and structural influences on the disparate external funding experienced by historically underfunded groups.

Methods: The quantitative phase of a mixed-methods study will be presented. Underlying research questions and analysis include:

1. Which intersections of identities reveal the highest levels of inequality? (Lorenz curve and Gini index)
2. Do intersections of identities significantly influence the likelihood of receiving an award? (logistic regression)
3. To what degree do intersections of identities influence the funding award amount? (linear regression)

Results: Results of this research are forthcoming. Preliminary analysis of aggregated data and pilot interviews shows insights. Findings from 5,386 grant applications indicate that women are 69.8% less likely to receive government funding and receive fewer dollars when funded, while Black faculty are 30% less likely to secure non-federal, non-industry funding. Pilot interviews with successful women faculty of color reveal systemic barriers, including exclusion and lack of social capital, but also highlight success factors like mentorship, networking, and institutional support.

Conclusions: Systemic barriers perpetuate research funding disparities. The assumption that merit alone determines success overlooks historical inequities, reinforcing neoliberal ideologies. Instead of regressing under the current executive branch's anti-DEI agenda, we must push forward with policies that promote inclusivity and equitable opportunities in academia.

Queueing Theory Applications to Increase Efficiency in Hospital Bed Allocation

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Background: Queuing theory is not new, but it has only recently begun to be used in healthcare effectively. Hospital management is the most important problem for public utility. The chief aim of the hospital is to provide better facilities and quicker service to the patients coming for treatment. The hospital management needs to properly arrange the allocation of beds for patients in different wards and the deployment of doctors for efficient and quick service.

Methods: The present study aims to show how a queuing model may be used to optimize the allocation and use of hospital beds to improve patient care. Here, a multi-channel queueing system with Poisson arrival and exponential service time following a 'first-come-first-served' pattern is taken into consideration. The arrival pattern of the patients and the average length of stay of the patients for male, female, labor, and emergency wards separately have been calculated from the appropriate records of the hospital

Result: The increase of available beds to 4 in the male ward, 4 in the female ward, 3 in the labor ward, and 4 in the emergency ward would reduce wait times to 60 minutes, 15 minutes, 34 minutes, and 19 minutes, respectively.

Conclusion: Use of queuing theory is very important in hospital management. An increase in the bed allocation in various wards of a hospital will reduce the wait times to a tolerable limit for patients, and efficient service can be provided.

Comparing Social Capital Among Muslims, Immigrants, and Americans: Does Origin and Religious Affiliation Matter?

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Background: The objective of this paper is to understand to what extent Muslim immigrants have different levels of social capital compared to non-Muslim immigrants and Americans. Research comparing the community engagement and volunteer activities of Muslim immigrant communities, to non-Muslim immigrants, and Americans is particularly minimal.

Methods: The study uses nationally representative data from the Current Population Survey: Volunteering and Civic Life Supplement in 2017, 2019, and 2021. The study uses a non-experimental associational research design and conducts a binary logistic regression analysis with an overall sample size of 349,592 (3,781 being Muslim immigrants).

Results: Results indicate that Muslim immigrants are less likely to get together with other people from their neighborhood or volunteer for an organization or association than non-Muslim immigrants and Americans. Muslim and non-Muslim immigrants are less likely to belong to any groups, organizations, or associations than Americans. There is no statistically significant difference between Muslim immigrants, non-Muslim immigrants, and Americans in regards to their likelihood of attending public meetings or interacting with people from a different racial, ethnic, or cultural background from theirs.

Conclusions: The study finds that migrant and religious status are significant for social capital. These findings support stratification and find that the concept can apply to underprivileged country of origin and differentiating nationality groups based on religious affiliation. We recommend that a better understanding of Muslim immigrant's challenges is crucial to promoting inclusive opportunities for community engagement among diverse populations due to Muslim immigrant's social capital being lower than non-Muslim immigrants and Americans.

VCU Life Sciences

Ecosystem Footprints: Insights into Mammalian Habitat Utilization and Taphonomic Processes in South Luangwa National Park

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Background: The seasonal undammed Luangwa River in Zambia is an ecosystem critical to human evolutionary studies. The goal of the Zambia Rift Valley Research Project is to examine mammalian community dynamics through live animal census surveys and taphonomic investigations of varying Luangwa habitats to facilitate interpretations of hominin paleoenvironments.

Methods: Systematic taphonomic surveys of the South Luangwa National Park. Surveys were done across diverse habitat types, including floodplain, woodland, and grassland, during both wet and dry phases of the river's annual cycle. Skeletal materials were documented in situ and collected when feasible. Live animal census data was also collected to comparatively analyze spatial and

seasonal patterns in mammalian presence and preservation. GIS was employed to visualize habitat types, animal distribution, and taphonomic patterns.

Results: Mammalian distribution is influenced by temperature, time of day, seasonality, and river proximity. Systematic bone-walk surveys revealed that in seasonal riverine habitats, larger taxa have higher skeletal preservation in densely vegetated areas, while grasslands yield more remains from smaller species, suggesting selective predation. Spatial analyses show a disconnect between living and dead animals: live animals were mostly observed in wetter regions, while skeletal remains concentrated in drier riverbeds. Spatial modeling identified environmental variables affecting species distribution and interactions with river geomorphology.

Conclusion: These findings stress the significance of habitat structure in interpreting taphonomic data. Our results increase our comprehension of contemporary mammalian community dynamics in Zambia but also provide a critical framework for comparing modern ecosystems with the paleoecological landscapes where early hominins may have roamed.

Statistical Analysis of Vessel Shipping in the Arctic: Back casting Decision-Making with Vessel Speed to Quantify Environmental Risks

Mauli Pant

VCU Integrated Life Sciences

Background and Motivation: The Arctic Northwest Passage (NWP) presents new maritime opportunities but also significant risks due to dynamic environmental and ecological challenges. This study uses AIS data from 2010 to 2019 to analyze vessel speed as a key metric for back casting decision-making. Environmental factors: sea ice concentration, wind patterns, and whale distribution are assessed for their influence on navigational risks. The findings establish a baseline for past risks, facilitating informed decision-making for future Arctic maritime operations.

Methods: Spatio-temporal kriging interpolates missing data on sea ice, wind, and bathymetry. Generalized Linear Mixed Models (GLMMs) quantify the impact of environmental factors on vessel speed, accounting for spatial and temporal dependencies. A Gamma distribution with a log link is applied to address excess zeros in speed data, with a dispersion model to account for heteroscedasticity.

Results: The spatio-temporal overlap between vessel and ice data facilitated the assessment of ice-related risks using the Arctic Climate Change Economy Society (ACCESS 2015) safe speed thresholds. Approximately 40% of vessels from 2010 to 2019 were exposed to ice-related risks. GLMMs reveal significant relationships between Speed Over Ground (SOG), ice concentration, and wind speed. The model explains 67% of SOG variability compared to Null model, with spatial random effects explaining the 31% of the variance. Vessel group interactions with ice concentration provided insights into how different vessels adjust speed to varying ice conditions. Furthermore, interactions between vessel status and bathymetry showed how navigational status and ocean depth influence SOG and navigational decisions.

Discussion and Future Work: Future research will integrate whale distribution data to assess collision and ship strike risks, contributing to an optimization model that minimizes Arctic shipping risks.

Identification of microRNA Biomarkers for Predicting Body Weight and Muscularity in Forensic Samples

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Background: Forensic DNA phenotyping (FDP) utilizes genetic markers to predict externally visible characteristics (EVCs) of unknown individuals, especially in cases lacking suspects or database matches. Recent studies suggest that microRNA (miRNA) expression is influenced by external factors such as metabolism and physical activity. This study introduces an innovative FDP approach exploiting miRNA expression profiles from blood and saliva to predict an individual's body weight and muscularity classes.

Methods: Comprehensive body composition was assessed via bioelectrical impedance analysis. DNA extracts from whole blood and saliva were analyzed using reverse transcription-quantitative PCR (RT-qPCR) to evaluate miRNA expression. Additionally, high-throughput sequencing (HTS) of RNA extracts was performed to identify potential miRNA markers linked to body weight and muscularity.

Results: Analysis of 100 blood and saliva DNA extracts revealed associations between body weight categories and specific miRNAs, such as miR-145-5p and let-7i-5p. HTS of selected samples identified several differentially expressed miRNAs involved in metabolic regulation, exercise adaptation, and muscle cell differentiation, offering promising targets for further validation.

Conclusions: This study highlights the predictive ability of miRNAs and contributes to the development of prediction models for environmentally influenced EVCs. Notably, the ability to detect miRNAs from DNA extracts reduces sample consumption and processing time while providing investigators with more identity-related information. Future work will focus on increasing sample size and verifying identified miRNA markers to enhance the accuracy of prediction models.

The influence of nonnative shrubs on foraging preferences and behavior in Golden-winged (Vermivora chrysoptera) and Chesnut-sided Warblers (Setophaga pensylvanica)

Samantha Fishman

Background: Shrubland and early successional habitat (ESH) support diverse wildlife, including declining songbirds. However, nonnative shrubs increasingly dominate these habitats, potentially altering habitat quality by influencing prey availability.

Methods: We examined foraging behaviors of Golden-winged Warblers (*Vermivora chrysoptera*; GWWA) and Chestnut-sided Warblers (*Setophaga pensylvanica*; CSWA) in ESH on private lands in Virginia with varying nonnative shrub cover. Using foraging observations, we assessed substrate preference, avoidance, and whether foraging behaviors (attack rate, movement rate, search effort) varied with substrate type or broader vegetation context.

Results: Both species preferred native plants while disproportionately avoiding nonnatives. Black locust (*Robinia pseudoacacia*), hawthorn (*Crataegus* spp.), and cherry (*Prunus* spp.) were the most preferred substrates. GWWA had higher movement rates on avoided substrates, while CSWA had higher attack rates on preferred ones. Foraging behaviors did not consistently align with optimal foraging theory when considering broader vegetative context. CSWA movement rate was marginally higher with more preferred substrates within 25m, and search effort slightly increased with greater native plant cover.

Conclusions: Our findings demonstrate a strong preference for native plants, but it is unclear whether prey availability on preferred substrates declines when surrounded by nonnative plants. Since nonnative shrub cover was always <40%, habitat quality may not be negatively impacted at these levels. This research informs private land management strategies to enhance habitat quality for shrubland birds in working landscapes.

School of Public Health

Prevalence and Associated Factors of Cannabis Use Across Canadian Provinces Before and After Cannabis Act and 2nd Amendment

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Background: In October 2019, the Government of Canada amended the Cannabis Act (CA2) to include additional cannabis products such as edible cannabis, topical cannabis, and cannabis extracts. This study examined province-level prevalence and factors associated with cannabis use – before and after CA2.

Methods: We extracted data from quarterly cycles of the Canadian National Cannabis Survey (NCS) for the years 2018–2020. Researcher used chi-square test to explore the provincial differences in Cannabis use before and after the amendment. Using multivariate and multinomial logistic regression, we also examined cannabis use and associated characteristics such as modes of consumption, sources, and product types, as well as factors influencing cannabis use such as Socio-demographic characteristics.

Results: In Canada, prevalence of cannabis use status changed from 15.5% (before Ac2) to 20.3% (after AC2). Nova Scotia had a higher rate of cannabis use, whereas Quebec and Saskatchewan had a lower rate. Our adjusted regression models revealed that the increase in cannabis use after AC2 was driven by factors such as increases in in non-medical cannabis use, consuming edible cannabis, and obtaining cannabis from illegal sources. It is notable that obtaining cannabis from illegal sources increased after expanded legalization, other things equal. (All p <0.05). Variability in cannabis use was also observed within provinces over time.

Conclusions: This national trend analysis pointed to statistically significant changes in cannabis use after cannabis legalization and AC2. Consistent monitoring of cannabis uses, and other cannabis-related outcomes is crucial to inform public health practice and policy in Canada.

Association of Comorbidities, Surgery, and Insurance Coverage with 30-Day Hospital Readmissions Following Treatment of Metastatic and Non-Metastatic Colorectal Cancer: Evidence from Florida (2019)

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Background: Colorectal cancer (CRC) ranks among the top three cancers in high-income nations. Despite extensive research on CRC's biological mechanisms and epidemiology, the impact of comorbidities on 30-day readmission rates remains unclear.

Methods: We conducted a cross-sectional study using 2019 data, stratifying CRC patients by metastatic status. Logistic regression assessed the associations between 30-day readmissions and comorbidity count. Models were adjusted for patient factors (age, sex, race, insurance, CRC procedures, admission type), hospital characteristics (location, size, system type, ownership, electronic health records implementation), and community-level factors (county-level supply of primary care physicians and specialists, household income, education, Medicare Advantage, and the Herfindahl–Hirschman Index).

Results: In nonmetastatic CRC patients, having 2–3 or 4+ comorbidities increased the odds of a 30-day readmission by approximately 2.76 and 2.99 times, respectively, while Medicaid coverage (versus Medicare) raised the odds by 1.52 times and CRC surgery reduced them to 0.18. In metastatic CRC patients, having 4+ comorbidities and Medicaid coverage increased the odds by 1.72 and 1.35 times, respectively, with CRC surgery lowering the odds to 0.18; additionally, a higher supply of primary care physicians increased the odds by 2.42, whereas a greater number of specialists reduced them to 0.68.

Conclusions: Among CRC patients, a higher comorbidity burden and Medicaid coverage are associated with worse outcomes, with metastatic patients also facing care fragmentation. Access to surgery reduced 30-day readmission rates. Policy recommendations include enhancing chronic disease management, improving coordination between care providers, and addressing Medicaid disparities to optimize patient navigation and outcomes.

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Case-Control Study of Dietary Factors and Advanced Glycation End Products Among Screening Colonoscopy Patients

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Background: SPARK (Study of Sleep and Adenoma Risk) is a case-control study among African American (AA) and European American (EA) patients undergoing a screening colonoscopy for colorectal cancer (CRC) that will test the hypothesis that disruption of circadian rhythms and sleep is associated with gastrointestinal (GI) inflammation (cytokine expression) and colorectal adenoma formation. Sleep is quantified via wrist actigraphy, and sleep stage is quantified using the OURA ring over one week. Heart rate variability is measured via 24-hour ambulatory heart rate monitoring. Patients donate peripheral blood, an overnight urine sample, and a normal GI tissue biopsy. Through the structure of SPARK study, the role of Advanced Glycation End Products (AGEs), including soluble receptor for AGEs (sRAGE) and carboxymethyl lysine (CML) is being investigated in colorectal adenoma risk. The objectives through the role of AGEs in the SPARK study are to identify dietary and other factors such as race, demographic and behavioral characteristics, psychophysiological stressors, sleep patterns, and social drivers of health related to CML and sRAGE.

Methods: 168 participants from the SPARK study who donated peripheral blood samples were used for analysis, including 84 samples from patients with colorectal adenomas and 84 samples from patients without.

Results: Results determined that participants with a higher dietary inflammatory index score and negative social drivers of health contributed to a higher CML and lower sRAGE rate.

Conclusion: Upon analysis of results, dietary and other factors such as race, psychophysiological stressors, sleep patterns, and social drivers of health contributed to an increased CML and decreased sRAGE concentration.

Connecting the dots on Malaria Awareness, Attitudes, and Practices Among Slash & Burn Cultivators in Rangamati, Bangladesh

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Background: Malaria remains a disease of concern, especially among risk groups like slash & burn cultivators, living in remote hill-tracts of Bangladesh and yet little research can be found among them.

Method: With an aim to assess the knowledge, attitude and practice among such groups for malaria prevention, an exploratory mixed method study consisting of 4 FGDs and a structured survey with 200 participants, was conducted in Rangamati hill-tracts.

Result: The findings showed that while these groups generally recognize how malaria is transmitted and its symptoms, there are still gaps in their understanding of preventive measures and treatment-seeking behaviors. Although participants acknowledged the serious implications of sleeping or working outside without protection and mentioned they seek care within 24 hours of falling ill, there was a common belief that they could simply buy anti-malarial drugs from a drug store. The study further found a connection between participants' knowledge about malaria transmission and their attitude towards malaria control programs, which influenced their preventive and treatment-seeking practices. It also highlighted the importance of understanding the specific needs and behaviors of different risk groups to effectively combat malaria and improve health outcomes in these remote regions.

Conclusion: These insights provide valuable information for Bangladeshi policymakers, suggesting the need for targeted information campaigns on malaria transmission and prevention to address and correct persistent misconceptions. There should be continued surveillance using checklists, improved Advocacy, Communication and Social Mobilization

(ACSM) activities, and increased research focusing on different at-risk groups, such as the slash-and-burn cultivators.

Evolution of the HIV Envelope Protein and Its Connection to HIV Reservoir Dynamics: Longitudinal Analysis Over 13 Years

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Background: HIV-related morbidity and mortality have significantly declined due to the use of combination antiretroviral therapies (ART), making an HIV diagnosis no longer a fatal outcome when properly treated and managed. However, discontinuing ART leads to viral resurgence, requiring lifelong adherence to treatment. Given the numerous challenges associated with long-term treatment adherence, finding a cure to eliminate the persistent viral load in infected individuals remains a critical priority, emphasizing the importance of HIV eradication. A major obstacle to achieving HIV eradication is the persistence of cells harboring replication-competent HIV, collectively known as the HIV reservoir. Research on the HIV reservoir reveals that the composition of proviruses changes dynamically during ART. The HIV envelope glycoprotein binds to CD4 cell receptors to mediate viral entry, potentially facilitating immune system evasion within the HIV reservoir. In this study, we aim to investigate the envelope protein to further define its compositional changes overtime and explore its connection to proviral decay and the persistence of the HIV reservoir.

Methods: We created a bioinformatic pipeline that automatically analyzes temporal HIV amino acid sequence data to detect changes in HIV proteins over time.

Results: Our analysis revealed multiple alterations in specific regions of the protein including insertions, deletions, and other modifications throughout the dataset that correspond with the changes in the reservoir dynamics.

Conclusion: This long-term, multi-subject analysis provides a unique opportunity to track measurable compositional changes over time, addressing critical gaps in our understanding of HIV persistence.

Investigating Cancer Outcomes in Virginia's SWANA Community with Surname-Based Machine Learning

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Purpose: This study develops and validates a South West Asian and North African (SWANA) Surname Algorithm (SSA) to identify SWANA patients within cancer registries, enabling inclusive evaluation of cancer burden by race/ethnicity among adults in Virginia.

Methods: We created an algorithm predicting SWANA descent from surnames using phonetic (Soundex, Metaphone), linguistic (n-grams, vowel/consonant counts, prefixes, suffixes), and feature-engineered attributes. A SWANA Surname List (SSL, N=17,712) was derived from Virginia birth and death certificates (1995-2020, N=340,855) and cross-referenced with Virginia Cancer Registry data (1995-2020, N=1,419,833). An XGBoost model optimized for area under the curve was trained and evaluated using confusion matrices and accuracy metrics. Cancer outcomes were analyzed, adjusting for demographic and behavioral factors.

Results: The best model achieved 95.2% accuracy and 84.5% sensitivity. Preliminary SSL analysis identified 1.7% of cancer patients as potentially SWANA, with a rising trend over time. SWANA individuals had a 23.1% chance of late-stage diagnosis, while White patients' likelihood decreased slightly by 0.4% (to 22.8%) upon excluding SWANA individuals. Black patients exhibited the highest probability of late-stage diagnosis, significantly differing from White patients ($p<0.05$).

Conclusions: The XGBoost SSA demonstrated high accuracy and specificity but moderate sensitivity in identifying SWANA-origin surnames. Misclassification risks obscuring significant cancer disparities for SWANA and other racial groups. This methodology can disaggregate race/ethnicity in absence of granular data. Future work incorporating NLP and deep learning will enhance classification accuracy and explore disparities in cancer outcomes among the SWANA community.

Assessing Unmet Substance Treatment Needs Due to Insurance Barriers: Insights from the 2022 NSDUH Survey

Ameera Ba-Fadhel, MPH – VCU Humphrey Fellow 2024-25

Background: Substance use disorders (SUDs) remain a critical public health issue in the U.S., yet treatment access remains limited. Despite expanded insurance coverage through the Affordable Care Act (ACA) and the Mental Health Parity and Addiction Equity Act (MHPAEA), financial and insurance-related barriers prevent many individuals from receiving necessary care. This study examines the extent to which insurance limitations contribute to unmet treatment needs for individuals with SUDs.

Methods: Using nationally representative data from the 2022 National Survey on Drug Use and Health (NSDUH), this study analyzed treatment access among adults aged 18-64 with SUDs. Logistic regression models were applied to assess the association between insurance status

(private, public, or uninsured) and unmet treatment needs, adjusting for sociodemographic and health-related factors.

Results: Among individuals needing SUD treatment, 29.8% reported unmet needs due to insurance-related barriers. Uninsured individuals had significantly higher odds of experiencing unmet treatment needs compared to those with private insurance (aOR = 2.45, $p < 0.001$). Those with public insurance also faced increased barriers (aOR = 1.67, $p < 0.05$). Financial constraints further exacerbated disparities, with individuals citing cost concerns being 3.21 times more likely to report unmet treatment needs ($p < 0.001$).

Conclusion: Insurance-related barriers significantly limit access to SUD treatment, particularly among uninsured and low-income populations. Addressing these disparities through Medicaid expansion, enhanced insurance coverage, and reduced financial burdens is essential to improving treatment access and advancing health equity.